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Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

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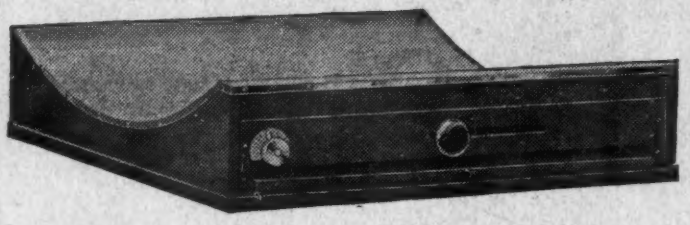

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SURGERY, GYNECOLOGY AND OBSTETRICS

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MOBILIZATION OF THE ELBOW BY FREE FASCIA TRANSPLANTATION WITH REPORT OF THIRTY-ONE CASES[1]

BY W. RUSSELL MACAUSLAND, M.D., BOSTON
Surgeon-in-Chief, Orthopedic Department, Carney Hospital

IN a previous paper (38), read before the Orthopedic Section of the American Medical Association on June 23, 1914, I reported 4 cases in which I had gained mobility in ankylosed elbow-joints by means of arthroplasty. In 2 of these, I used the Murphy method interposing pedunculated flaps of fat and fascia; in 2, free flaps of fascia lata. At the same time, I gave a résumé of the literature on previous attempts at mobilization in this joint. I should now like to consider briefly the contributions which have been made to date to the literature on this subject and also to report my arthroplasties in full.

Ankylosis of the elbow results either from an infectious process or from traumatism. The latter is usually a fracture dislocation with wide separation. The large amount of callus which forms as a result of this injury at first interferes mechanically with motion; later, an ankylosis results, usually fibrous in character.

The infectious process may be either acute or chronic. In the former case, the causative agent is usually the streptococcus, the pneumococcus, or the gonococcus. The onset is sudden and the course severe, ending usually in a bony ankylosis.

We may, on the other hand, have a slow, insidious, polyarthritic process. The focus of infection is situated elsewhere, and the joint condition is caused by the hæmatogenous deposits in the joint, either of attenuated bacteria or of toxins. The primary focus is often difficult to locate. The ankylosis results from adhesions both within and without the joint and is, at least at first, fibrous.

In the problem of treatment of any ankylosis, the location of the joint has to be considered. In the elbow, conditions are different from those in any other of the large joints. In the lower extremity, stability is far more important than motion. Here, particularly at the knee, a firm, painless joint in good position is far more useful than a wabbly one continually subject to strains and wrenches. In a shoulder ankylosed in an abducted position, a useful degree of motion may be had by the resulting hypermobility of the scapula. A stiff wrist in a good position, i.e., hyperextension, is serviceable; moreover, as structures here are complicated, the joint does not lend itself readily to arthroplasty. In the elbow, on the other hand, no position of ankylosis is favorable to function and any position is ungainly.

Many methods have been tried to gain mobility in the elbow. Various nonabsorbable materials have been used. Gluck and others inserted ivory pegs; Pupovac, magnesium sheets, and other metals. Besides these, wood, celluloid, gutta percha, and temporary packings of gauze have been used. Taylor (67) advocated a mixture of yellow wax and lanolin.

[1]Read before the Southern Medical Association, November 15, 1920.

Widely varying organic substances have been tried. Rechet (57) covered the ends of the resected bones with periosteal flaps in various joints. Hofmann (32), in 1906, reported a case in which he transplanted periosteal flaps from the tibia to the resected end of the bones of the elbow. He obtained full extension and flexion to 80 degrees.

Weglowski (74) reported a case in which he used successfully cartilage transplanted from the rib in an ankylosed elbow.

Von Frisch (23) used periosteal grafts from the tibia in an elbow ankylosed from gonorrhœal arthritis. Only 25 degrees motion was obtained. The author attributed the result to lack of after-treatment.

Herzberg (30) reported 4 cases in which transplantation of joints was done after resection. Ankylosis was the result of trauma. Three of the cases were children.

Greiffenhagen (26) reported 3 cases in which periosteum was used in elbow-joints.

Mauclair (39) used cartilage from the astragalus to cover the rough ends. X-ray later showed these fused to the bone.

More recently, cartilage grafts were used by Delangenière (16) after a resection had been done. The operation showed no advantage over an excision, as some instability of the joint followed. These methods have now been abandoned.

Excision has a few advocates but, except for this, arthroplasty has succeeded all other methods. The first case reported is that of Verneriel (72) in 1860. He gained motion by the use of a flap of muscle and fascia, interposed after resection of an ankylosed jaw. Helfereich's (28) report, however, in 1893 brought the matter to more general attention. He also used a muscle flap for interposition.

Albarran (1) reported a case in which ankylosis had followed operative reposition. A partial resection was then done by which a good immediate result was obtained but later ankylosis again occurred. A third operation was undertaken which consisted of a resection of the olecranon and interposition of a muscle fascia flap of the triceps. After two years, there was a range of motion from 65 to 115 degrees. Extension was possible without the aid of gravity. Pronation and supination were normal. There was no lateral motion.

Nélaton (45), in a case of ankylosis following a neisserian infection, resected an elbow and interposed a flap of the brachialis anticus. Two years after the operation, flexion and extension were normal, but pronation and supination were much decreased. Active extension required the weight of gravity.

In 1903, Quénu (56, b) reported an arthroplasty of the elbow for an ankylosis following a severe trauma of the arm, consisting of a fracture of both bones of the forearm and destruction of the soft parts. After resection, he interposed a tendon fascia flap. There resulted flexion to a right angle and good but incomplete extension. There was good pronation but difficulty in maintaining an intermediate position. The patient died a few months after the operation of pulmonary tuberculosis.

Delbet (17) also reported mobilizing an elbow in a girl of six, which had become ankylosed in infancy, resulting in complete atrophy of the arm. At his first operation, he resected the joint without breaking up the ankylosis. Two months later after re-ankylosis, he intervened again, removing the bony spicules that had formed, 0.5 centimeter thick, from the humerus, the radius, and the ulna, and interposing some fibers of the flexor carpi ulnaris. Chloroform mobilization was necessary a month later but the final result was good, with flexion to a right angle and extension nearly complete.

Berger (7), in the same year, mobilized a fibrous ankylosis by remodeling the bony parts and inserting a flap of the anconeus which he sutured to the brachialis anticus. He had not at the time of his report obtained active motion.

Schanz (62), in 1904, reported a mobilization of a bony ankylosis following rheumatism. After chiseling through the joint, he enlarged the sigmoid fossa, removed a piece of the trochlea, and interposed a flap of fat from the under side of the forearm. Three months after the operation, the arm could be used for ordinary purposes.

Murphy (43,a) first used his fascia method October, 1901, on a knee-joint. A large layer of fascia lata with a thin layer of muscle tissue attached was dissected from the outer surface of the vastus externus, with its base below and anterior. A small flap of fascia covering the vastus internus was dissected free and placed between the patella and the femur. He first mobilized the elbow by this method in 1904 in a case of ankylosing arthritis. A pyriform flap of deep fascia was dissected from the posterior surface of the triceps. The flap was 4½ inches long by 2 inches wide at its upper end and received its blood supply from a broad pedicle which remained attached to the muscle and fascia just below the level of the olecranon. After the bony parts had been remodeled, the fascia was drawn down and turned into the joint around the inner margin of the olecranon. The proximal portion of the flap covered the trochlea, lined the olecranon depression and the lesser sigmoid cavity, while the distal portion covered the external condyle. Subsequent events showed that the flap was not carried sufficiently high on the anterior surface of the humerus to permit adequate flexion of the joint. Five months later, the patient could pass his hand through an arc of 5 inches. Pronation and supination were about one-half normal. His second case was reported 2 months after operation. The hand could be moved actively

Fig. 1.

Fig. 2.

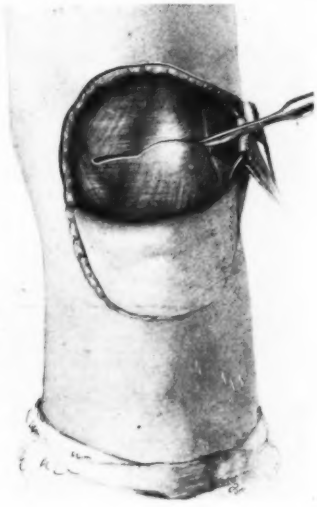


Fig. 3.

Fig. 4.

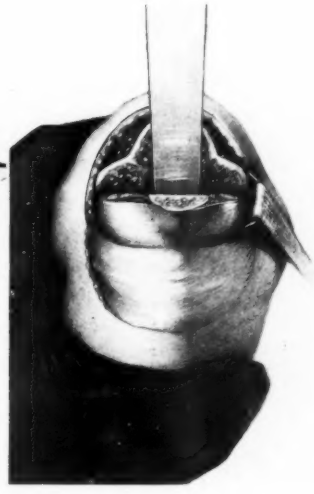


Fig. 5.

Fig. 6.

Fig. 1. Line of incision.
Fig. 2. Dissecting out ulnar nerve.
Fig. 3. Cutting through the muscle and fascia down to the joint.
Fig. 4. Sawing through olecranon and end of humerus.
Fig. 5. Splitting off tip of olecranon with chisel.
Fig. 6. Cutting out with rongeur forceps bit of olecranon tip left in humerus.

through an arc of 3 inches and the elbow forcibly flexed to an acute angle and extended to 160 degrees. Pronation and supination were approaching normal.

Hoffa (31), in 1906, reported a series of arthroplasties, seven of which were on the elbow. In one, a magnesium plate was used. This operation was unsuccessful owing to the formation of gas in the joint causing a fistula which closed only after the rest of the plate had been removed from the joint. The other operations in which fat, fat and fascia, or fascial flaps were used, were all successful. In 2 of these

Fig. 7.

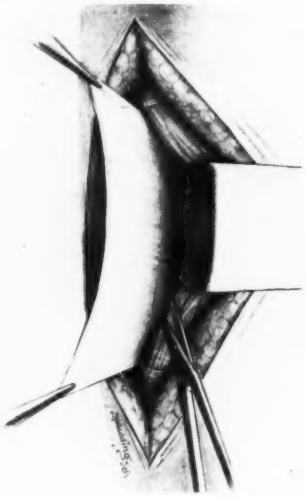


Fig. 8.

Fig. 9.

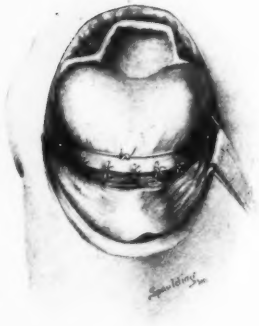


Fig. 10.

Fig. 11.

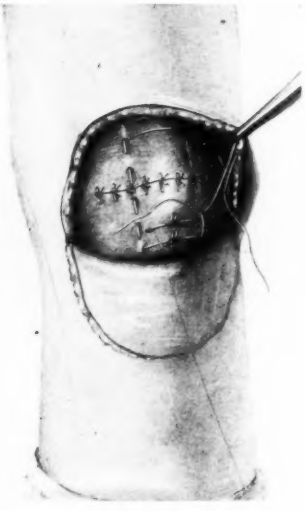


Fig. 12.

Fig. 7. Scooping out ulna and radius with curette.
Fig. 8. Cutting fascia lata from thigh.
Fig. 9. Sewing the flap of fascia lata to the elbow-joint anteriorly.

Fig. 10. Fascia sewed over humerus; tied with chromic catgut suture.
Fig. 11. Kangaroo suture throug hulna and olecranon tip.
Fig. 12. Stay sutures.

cases, the ankylosis followed scarlatina; in the others, gonorrhœal infection.

In 1905, Quénu (56,c) reported a third case in which there was great atrophy of the muscles. He used for a flap the inner part of the triceps sutured to the anterior ligament. Passive movements were begun in 10 days and later electrical treatment used but, as active motion was incomplete at the end of 2 months, he made a second intervention to recover a part of the tendon of the triceps, a large portion of

Fig. 13. Case 2. M. R. Roentgenogram showing ankylosis before arthroplasty.

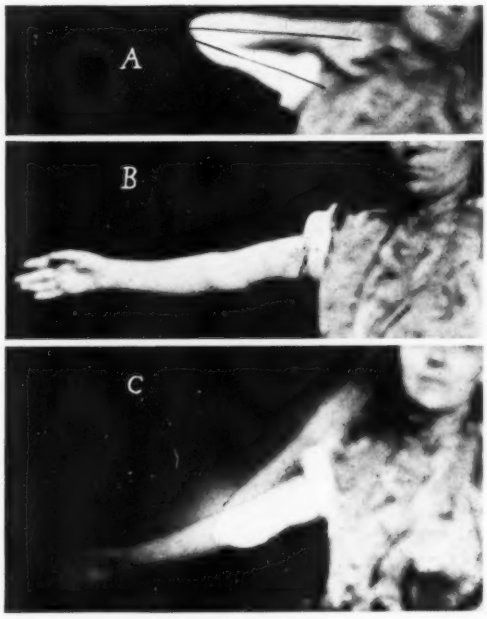


Fig. 14. Case 2. M. R. End-result. *a*. Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

which had been sacrificed. He cut the portion interposed close to the bone. He could then ascertain that there was no adherence between the superior surface of the interposed segment and the inferior cut surface of the humerus. The same condition obtained on the inferior surface. The tendinous segment had left a distinct cavity. The tendon of the triceps was sectioned and re-inserted on a little fibrous flap previously dissected on the forearm. The patient gained not quite complete extension and flexion to a right angle.

Dupuy (20), in 1905, reported 5 arthroplasties. Three of these were done by Jeannel, one by Kirmisson, and one by Launay. Jeannel used flaps of the brachialis anticus; Kirmisson, of the biceps; and Launay, a flap from the anterior ligament and the brachialis anticus. In all, good results were obtained. In two of Jeannel's cases, normal movements were obtained; in the other, the degree of motion was less but satisfactory function was gained. In Kirmisson's case, all the movements were present and the function good 5 months after the operation. Launay obtained passive motion from 80 to 155 degrees with free pronation and supination 5 months after the operation.

Huguier (35,a), in 1905, reported 2 cases operated on by Nélaton, with the interposition of a muscle flap. In one case, he gained good motion. In the second, re-ankylosis occurred. Huguier reported a third case by Ombredanne, by the same method.

Scudder (63) reported in 1906, 1907, and 1908, several cases in which he used Murphy's method successfully.

Pereira (50), in 1906, in an unreduced subluxation resected the ends of the bones and interposed a flap of triceps muscle with almost perfect functional result.

Bazy (6), in 1907, mobilized an elbow using a flap from the brachialis anticus. Nine months later, the function of the arm was almost perfect.

The same year, Stein (64) reported 3 cases from Bier's clinic in which triceps flaps were used. All were successful.

In 1909, Huguier (35,b) reported an ankylosis which he mobilized, using a flap of brachialis anticus. Sixteen months later, the patient could touch his shoulder with his hand and extend his forearm to 150 degrees.

Cifuentes (11) reported in the same year a similar arthroplasty in which he obtained a month after the operation a good functional result with normal movements.

In 1910, Reiner (58) reported a series of twenty-eight arthroplasties, twenty-five of which were given in full with the after-results. Two others, recent cases, were reported with good immediate results. In three others, the histories were unknown. Of the others, nineteen gave useful arms, although one was a flail joint which lacked power but could be controlled by the muscles. The poor results were due in one case, a fracture luxation, to extreme atrophy of the muscles, and in a tubercular case, to extensive resection of the diseased tissue necessary, resulting in a useless flail joint. Re-ankylosis occurred in two cases. In one, it was due to operation too soon after trauma, a fracture luxation, and lack of after-treatment. In the other case, the author attributes the result to the disease, myostitis ossificans.

Thom (68) reported in 1910 a case of ankylosed elbow operated on by Ritter. He used freely transplanted fascia lata as an insert after the parts had been made freely movable. On discharge, there was

Fig. 15. Case 3. R. T. Roentgenogram showing position of ankylosis before arthroplasty.

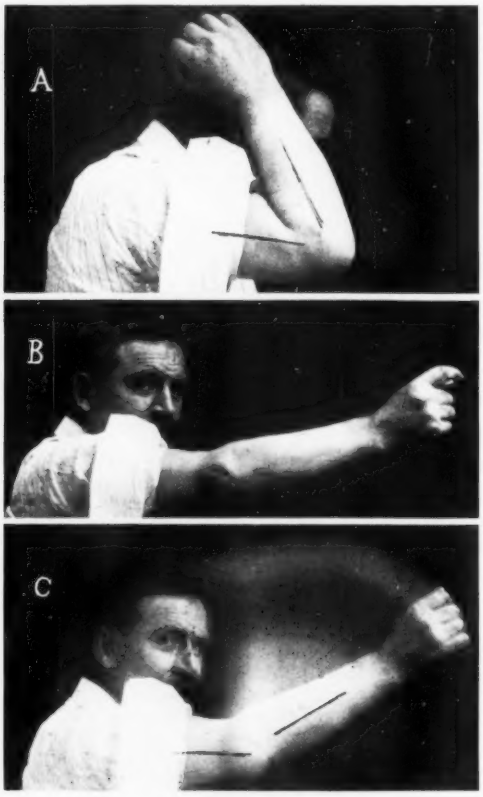


Fig. 17. Case 14. W. D. End-result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

Fig. 16. Case 3. R. T. End-result. At left, voluntary flexion; at right, voluntary extension.

65 degrees flexion and 100 degrees extension. Pronation and supination which were very slight before the operation were unchanged.

Wille (76), in 1911, interposed supinator longus fascia with good result, gaining 95 degrees motion.

Whitman (75) reported two cases of arthroplasty of the elbow in which he used Murphy's method.

In 1912, Edmunds (21) reported an elbow ankylosis following fracture in which this method was likewise used. At the time of the report, active motion was not possible on account of the great atrophy of the muscles.

Denk (19) reported two of von Eisenberg's cases in which elbow-joints were mobilized with free fascia transplants with good functional results.

Neff (44) reported a case in which he interposed a pedunculated triceps aponeurosis flap between the humerus and ulna and the radius and ulna. Seven months after the operation, there was active painless motion of 180 degrees to 30 degrees and only slight lateral mobility. The joints of the wrist and hand, which were previously partially ankylosed, regained from a third to a half their normal range of mobility with the return of function to the elbow.

Delbert (18), in 1912, reported having done nine resections of the elbow with articular grafts. Most of these were too recent to determine the results, but he reported in detail two cases which were of a year's duration and appeared permanent. In one of these he used cartilage from an ankle-joint, in the other cartilage from an elbow. Both gave good functional results.

Charput (10,a) reported three cases in which he resected a flap of fat the size of the palm from the thigh and encapsulated the lower end of the humerus with it, suturing it to the neighboring muscles by anteroposterior and lateral sutures.

Conrad (12), in 1912, published a dissertation on the use of muscle flaps as interposing material. We have been unable to obtain a copy of this thesis.

Pomponi (53) advocates the use of a pedunculated fascial flap by the method of Durante. He cites one case in which he gained complete pronation and supination, nearly normal extension and flexion to 60 degrees.

Murphy (43,b) reported among a series of arthroplasties done by him twelve on the elbow by his pedunculated fat fascia flaps.

Mauclaire (39) mobilized an elbow, using cartilage from the astragalus to cover the defects. One fragment was put on the lower end of the humerus,

another between the radius and ulna. A roentgenogram later showed these grafts fused to the bone.

Osgood (47) reported sixteen attempts at mobilization by various methods in the different joints. He advises against arthroplasty in the hands of untrained operators.

Putti (55), in 1913, reported his arthroplasties to date. These included twelve elbow cases in which he used Kocher's incision and a free flap of fascia lata. He obtained stabile joints with a useful degree of motion. His histological research is referred to elsewhere.

Roepke (59) reported ten cases of ankylosis of the elbow in which he did arthroplasties using free fat flaps to interpose between the joints. He advised against beginning passive motion too soon. One of these cases was one of arthritis deformans shown in 1911 before the Medical Society of Jena. In others, the ankylosis had resulted from trauma, neisserian infection, and tuberculosis.

Exner (22) reported a case fourteen months after an arthroplasty in which a free flap of fascia lata was interposed. The arm was somewhat unstable but gave good function. The patient could lift heavy weights. At the same time Pupovac reported a second case by the same method.

Darling (13) reported an arthroplasty with the use of a pedunculated flap done in the presence of active infection. The immediate result was good.

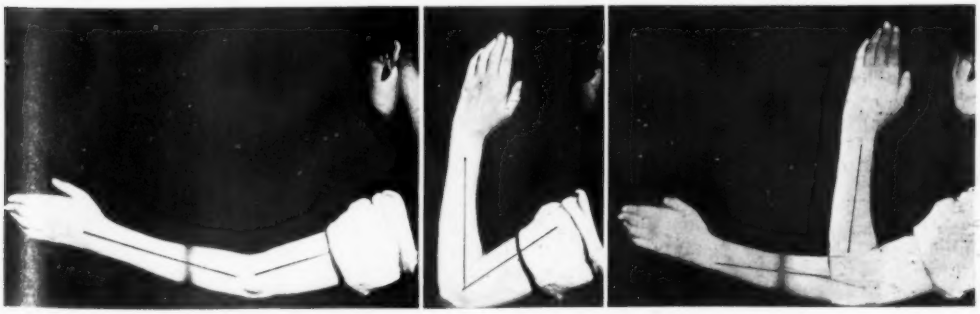
Harris (27) discusses the contra-indications to arthroplasty. He reports two elbow cases by the Murphy method. In one he gained 75 degrees motion. In the other, there was 60 degrees motion.

Turner (71) reported an arthroplasty of the elbow for an ankylosis following a severe osteomyelitis. There had been a musculospiral paralysis from which the patient made a perfect recovery. The elbow had entirely healed but, at the time of operation, a small area of latent infection was found. Turner used a posterior skin incision and inserted a flap of fascia lata. The elbow was put up in extension. The next day, there was a recurrence of the paralysis with signs of local infection. Later, fearing re-ankylosis, he manipulated the elbow under ether into extreme flexion. Six months later, the boy had motion from 50 to 120 degrees and a useful arm, though the muscles were still atrophied.

Fig. 18. Case 5. E. M. Above, Anteroposterior roentgenogram after arthroplasty; below, lateral roentgenogram after arthroplasty.

The same year Murphy (43,c) reported an arthroplasty by his usual method. The patient left the hospital in 5 weeks with free motion within an arc of about 45 degrees.

Vulpius (73) believes that the elbow and hip offer the best chances for arthroplasty. He prefers



a *b* *c*

Fig. 19. Case 5. E. M. End-result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion (not full range).

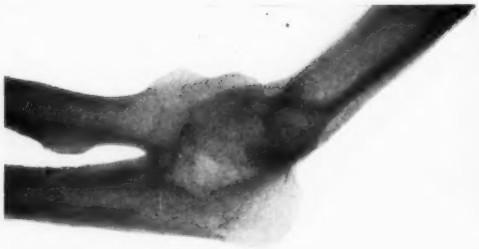


Fig. 20. Case 7. E. S. Roentgenogram showing position of ankylosis before arthroplasty.

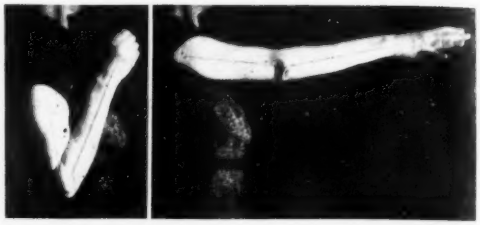


Fig. 21. Case 7. E. S. End-result. At left, voluntary flexion; at right, voluntary extension.

pedunculated flaps but also uses free flaps of fat or fascia and fat or Baer's membrane.

In 1914, Payr's (49) oldest case was about 4 years. He emphasizes the importance of removing the capsule or at least the synovialis as well as the fibrous cartilage. Payr has never met with a secondary dislocation nor a loose joint except in some of his first knee cases. The initial gain in motion was preserved or even increased with use. He had trouble with persistent swelling, more especially in cases where this had existed before operation for a considerable length of time or had been marked. He believes convalescence is shortened by waiting until the swelling has subsided. If re-operation is needed, he advises waiting at least 6 months. He reports twenty-two arthroplasties, of which three were elbows, one with a good result and two with very good results. He believes that if the indications are correct and the technique and after-treatment good, a favorable result is to be expected in 70 to 80 per cent.

Pupovac (54) reported a case of a girl of 19 whose elbow had become ankylosed at 130 degrees as the result of a severe arthritis. He did an arthroplasty using a posterior incision and a free fascial flap, gaining motion from 105 to 140 degrees. Five months later, he re-opened the joint and removed some exuberant bone that united the humerus with the ulna, gaining 70 to 130 degrees motion.

Owen (48) believes that the hip and shoulder offer the best fields for arthroplasty. The poorest prognosis is in the elbow and knee but if the former is ankylosed in extension, operation is advisable, as it will at least get the elbow into better position.

Davis (14) thinks that we should be conservative about opening a joint ankylosed by tuberculosis. He finds the elbow one of the most satisfactory joints for an arthroplasty as well as an excision but the results with the former are more brilliant. An excision requires the removal of one to one and one-half inches of bone to insure movement but, with an arthroplasty, only sufficient bone need be removed to interpose the flap and it is almost certain to give a stabile joint. He uses two pedunculated flaps, one from either side. The joint, he believes, should have drainage.

McCurdy (40) advocates the pedunculated flap in preference to the free flap, as he believes that the nutrition is better and that fascia will slough and require removal. He gives no experimental nor clinical evidence to bear out this statement. He prefers the Baer membrane, as it is more easily adjusted and there is, therefore, less blood clot; therefore less adhesions and better end-results.

Murphy (43,d) reported in 1915 a case of ankylosis following fracture. The elbow was ankylosed at about 150 degrees with a few degrees of motion. Seven weeks after operation, there was good pronation and supination and perfect freedom of motion.

Ashhurst (4) uses an incision along the external supracondylar line and the external condyle detached from the humerus with an osteotome. A pedunculated flap is inserted and the external condyle replaced by means of a Lambotte self-boring screw. He reports five cases. In these cases, there were three good end-results. One case had a flail joint with very slight power of extension. The fifth case had a limited motion but the patient refused forcible manipulation.

Gilbert (24) cites a case of dislocation of the elbow which existed 3 months. Good use of the joint was obtained after a Murphy arthroplasty.

Tubby (70) gives a careful consideration of the indications for arthroplasty. He believes that the best time for the operation is in early adult life, between 18 and 30 years. The mental state of the patient must be considered, as co-operation is essential; the occupation of the patient must be considered; the causative factor must be considered. The condition of the soft parts is important. A thin, scanty, and scarred skin will not be sufficiently nourished to stand the trauma. From the X-ray examination, an approximate opinion as to the condition of the joint is gained. He prefers a muscle flap for interposition but has also used fat and fascia and Baer's membrane. He does not begin passive motion for four weeks but thinks that active motion should be begun earlier. He reports one elbow case in which he used a muscle flap. At the time of the arthroplasty, insufficient bone was removed and re-ankylosis took place. Eight months later, he did a secondary operation to remove the mass of new bone. Following this, all movements were free but the elbow was slightly flail.

Fig. 22. Case 8. W. D. Position of ankylosis before arthroplasty.

Fig. 23. Case 8. W. D. Roentgenogram showing ankylosis before arthroplasty.

Charput (10,b) reported a case of arthroplasty for ankylosis following luxation of the elbow. He used two lateral pedunculated flaps and sewed the skin up tight. The arm was put up in a sterile dressing in extension. The following day, the arm was flexed. Mobility returned in 2 days. In 42 days, extension and flexion were complete and vigorous. He attributes the good result to sewing up the wound without drainage and the immediate mobilization.

Graff (25) describes a case in which he interposed a flap of triceps muscle with almost complete return of normal motion.

A brief report of an arthroplasty with a pedunculated flap is given in Kennedy's case (36). The end-result is not reported.

Murphy (43,d) reported a case showing perfect motion seven months after arthroplasty for ankylosis from a fracture. A second ankylosis from tuberculosis showed a good end-result.

Whitman (75) exhibited before the New York Surgical Society a case in which an arthroplasty had been done for a fibrous ankylosis following tuberculosis. Four years before, an arthroplasty had been done using a pedunculated flap. At the second operation, the fibrous ankylosis was found to have become bony. Whitman used a flap of fascia lata at this operation. Whitman believes that in an ankylosis following tuberculosis, a free fascial transplant is essential to success, as the tissues about the joint are atrophied. His case showed a perfect end-result with normal flexion and 165 degrees extension.

Brown (8) gained 80 to 150 degrees motion in an arthroplasty by the Murphy method. The arm had been ankylosed in extension following acute metastatic arthritis.

Rovsing (60) reported before the Northern Surgical Society 2 successful cases in which the Murphy method was used. The ankylosis was the result of fracture. In the discussion Bergman and Haglund expressed the opinion that mobilization of the knee should not be attempted.

Moszkowicz (42) in his report in 1916 on his operations on war injuries to joints, gives among other cases 6 elbow arthroplasties. In all of these, a useful degree of motion was gained.

Plummer (52) reported two arthroplasties in which he used pedunculated fat and fascia flaps. One of his cases became infected and subsequently a portion of the end of the humerus had to be removed. The resulting joint was somewhat flail but gave good function. His second case also had good motion but his facility for moving the joint was not very good.

McKenna (41) advocates a modification of the Murphy method. He uses a very long flap extending well out over the external condyle and an external flap for the head of the radius. He believes that success is more certain when the arthroplasty is done early, as the atrophic changes about the joint are less. For this reason, it is important to make a correct diagnosis of the infecting agent. The gonococcus lives a comparatively short time in the joint tissues and an arthroplasty may be done earlier in an ankylosis from this agent than in one from staphylococcus or streptococcus or a chronic infection as tuberculosis. In the discussion which followed, Gibbons reported an arthroplasty of the knee that had come to his notice in which hypermobility existed necessitating the permanent use of a brace.

Ryerson (61) gives in detail his operative technique in arthroplasty on the elbow-joint. He uses a long posterior incision avoiding the olecranon. The triceps tendon is cut and a thin shell of bone removed from the external condyle, taking the origin of the extensor with it. Then a shell from the internal condyle is removed. The joint is dislocated. After it is remodeled, a flap of fascia lata is used to interpose.

Thomson (69) reports the end-results in an elbow arthroplasty by the Murphy method. Ankylosis was the result of sepsis following a fracture. Seven months later, elbow motion was good but somewhat

a *b* *c*

Fig. 24. Case 8. W. D. End-result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

restricted. His successful cases have all been traumatic. He believes that neisserian infection is a contra-indication to arthroplasty, as it stimulates bone formation. Tuberculosis is also a contra-indication on account of the recrudescence of the disease.

Fig. 25 (above). Case 11. E. S. Roentgenogram showing ankylosis before arthroplasty.
Fig. 26. Case 11. E. S. Roentgenogram showing dislocation after arthroplasty.

Ceccarelli (9) used strips of fascia lata in an arthroplasty on a post-traumatic ankylosed elbow. The end-result was perfect flexion, extension to 165 degrees, and almost normal pronation and supination.

Olivieri (46) reports two arthroplasties with interposition of strips of brachialis anticus. The end-results were perfect.

In 1918, Baer (5) reports in full his arthroplasties to date, by the use of chromatized membrane. In one hundred cases, there were three arthroplasties on the elbow-joint. In one of these, re-ankylosis took place, one died, and the third showed 25 degrees motion. He believes that the elbow is the least favorable joint for arthroplasty and that the success from the interposition of muscle or fascial flaps is due to the amount of bone removed rather than to the flap itself and that these operations are in fact excisions. In the discussion of this paper, Galloway and Freiberg express the opinion that an arthroplasty has no advantage over an excision. Davis states that with an arthroplasty a more stabile joint is obtained.

Albee (2) uses a vertical incision directly over the olecranon. After retracting the ulnar nerve and dissecting the soft tissues, he saws through the olecranon from within outward. After remodeling the joint, he interposes a flap of fascia lata containing as much fatty tissue as possible. The arm is put up in plaster at right angles. After 10 days, passive motion is begun.

a *b* *c*

Fig. 27. Case 11. E. S. End-result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

a *b* *c*

Fig. 28. Case 12. M. D. Motion 4 months after arthroplasty. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

Henderson (29), in 1918, tabulated the end-results of the 43 arthroplasties done at the Mayo clinic. Twenty-one of these were on the elbow. He found the prognosis most favorable in the jaw and next in the elbow. The knee was the most unfavorable position. In reports from other surgeons he found a general agreement as to prognosis.

Kerr (37) reported an arthroplasty of the elbow, giving in detail his method of operation. He interposed some peri-articular fascia. The result was a useful, movable joint with no atrophy of the muscles.

Hohmann (34) reported 5 elbow arthroplasties in 1918 in which he inserted part of the triceps with good immediate results. Lange at the same time showed 6 cases in which useful joints were obtained and the patients were enabled to resume their old occupations. He used fat or muscle flaps.

Murphy's (43,a) experiments on animals led him to conclude that fatty tissue was essential to the new joint foundation. This fatty tissue, he believed, under pressure formed connective tissue and the breaking down of fat globules together with this hyperplasia of connective tissue resulted in the formation of bursæ. Similar results were reported by his assistant, Neff.

Sumita (66), in 20 experiments on dogs, interposed muscle and tendon as well as fascia between the surfaces of resected joints and found no marked difference resulting from the tissue used.

Davis (15) found that the interposed fascia did not degenerate but preserved its normal histological characteristics. Putti (55) came to the same conclusions.

Hohmeier and Magnus (33) obtained the same end-results with and without the interposition of living tissue.

Allison and Brooks (3) studied the production of joints with free and pedunculated fascial transplants and also with chromacized membrane and fascia impregnated with silver nitrate. They found no difference in the end-result between pedunculated and free flaps. They found with Baer's membrane the reaction of the surrounding tissues was of such intensity that even at the time the membrane was disintegrating there were formed adhesions between the granulating surfaces. The silver impregnated fascia caused relatively little reaction in the surrounding tissues.

Steindler (65) found in experiments on a small series of dogs that no adhesions were formed after scraping the cartilage covering either with the insertion of fascia or in controls. Pedunculated muscle fascia flaps were transformed with a con-

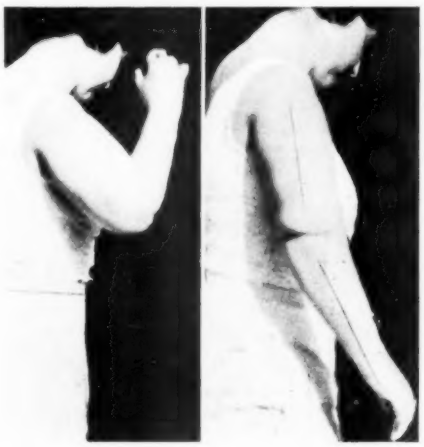


Fig. 29. Case 15. L. P. End-result after arthroplasty. At left, voluntary flexion; at right, voluntary extension.

Fig. 30. Case 17. I. H. End-result. At left, voluntary flexion; at right, voluntary extension.

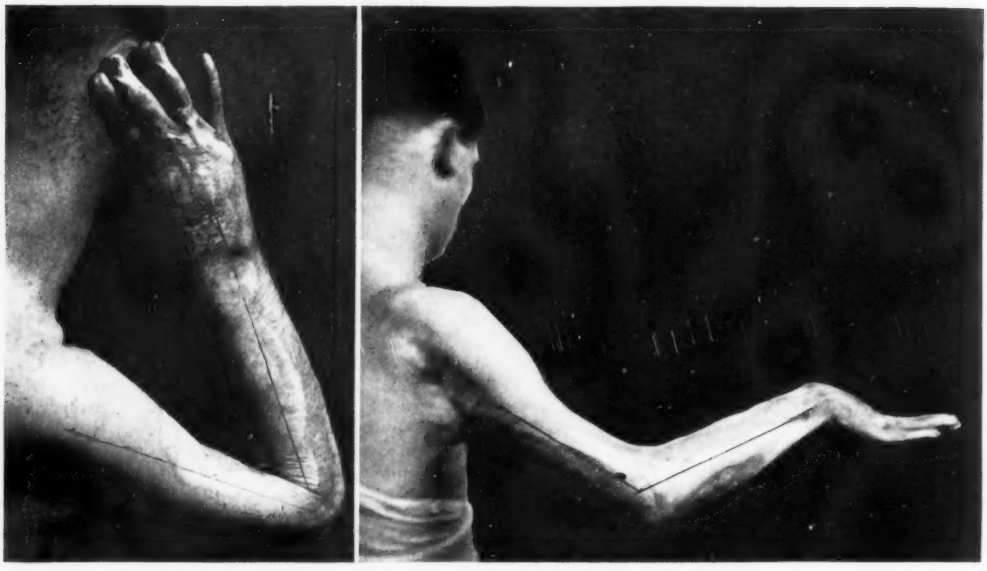


Fig. 31. Case 19. J. T. End-result. At left, voluntary flexion; at right, voluntary extension.

nective-tissue pannus adherent to the denuded areas of the bone. The denuded areas showed lacunar reformation of cartilage but no re-formation of bone.

Phemister and Miller (51) obtained similar results in the elbows and knees of dogs whether no interposing material was used or free or pedunculated flaps were used. The flaps largely break down and the resulting joints are alike in the three types of operation. They do not see how any appreciable amount of nutrition can be furnished by the circulation through the pedicle. They believe that the circulation in the surviving portions is through adhesions to the parts with which they come in contact.

INDICATIONS AND CONTRA-INDICATIONS

No attempt at mobilization should be made until epiphyseal growth has ceased. If it is made before this, it is impossible to remove sufficient bone to secure good motion without grave danger of injury to the epiphyseal line. Ankylosis is almost sure to result.

Where the joint has been the seat of an infectious process, arthroplasty should not be done until all signs of an active process have ceased. As a rule, however, we should not wait too long, as convalescence is lengthened where atrophy of the soft parts from disuse is marked. The exception to this rule is in the case of a tubercular joint. Here, it is a matter of considerable question as to whether an arthroplasty should be done. If at all, it should be done only very late, a number of years after all acute symptoms have subsided. Even then we run a risk of lighting up a quiescent process.

OPERATIVE TECHNIQUE

The arm from the wrist to the shoulder and the leg on the same side from the hip to the knee are given a two-day preparation. At the time of the operation, a tourniquet is applied to the upper third of the arm and an application of iodine made to the skin.

A semicircular incision is then made, beginning over the external condyle (Fig. 1) running down about 2 inches and up over the internal condyle. The wound is sponged with alcohol and carefully clamped off to avoid handling the skin during the operation. The flap containing skin and superficial fascia is then dissected back to the base line and retracted. The ulnar nerve is isolated and dissected out of its sheath (Fig. 2). It is sometimes difficult to find this nerve, but it is always to be sought at the inner side of the in-

ternal condyle. It should be dissected out carefully with a blunt dissector so as not to break nor injure it. After it has been freed for 1.5 inches, gauze is passed beneath the nerve and it is retracted to the ulnar side. It is then freed further with blunt dissection with gauze.

A transverse incision is then made extending down through the periosteum (Fig. 3). This incision follows in direction the superficial one and outlines a flap which is to be dissected back and preserved *in toto* for subsequent covering for the joint. The pulling back of this flap is a hard and tedious process until it is well started, after which it can be peeled back readily by blunt dissection. It is the inner side that is the hard part, as the layer is thin here and we must exercise great care not to buttonhole it. The olecranon is then sawed through. After this, it is frequently possible to break open the old joint. In some cases, however, ankylosis is bony and the joint cavity obliterated. Cases of this kind are the most difficult. It is in these cases necessary to saw through the joint. The tip of the olecranon has to be chiselled out and dissected back with its posterior flap. Usually the olecranon is too large and it is well to take off a little of it.

The capsule, fascia, and ligaments are then dissected back so as to allow the lower end of the humerus to protrude into the wound when its edges are snipped off with rongeur forceps and a new trochlear or intercondylar surface formed. A shoemaker's rasp is used in filing the extremity as near like the normal humeral end as possible. After this modelling, a piece is removed corresponding to the olecranon fossa in the normal humerus. One has to be careful about making this cup, as the success of the operation depends largely upon attention to such small details. This modelling is largely done with a saw and a file.

To insure good function, the joint surfaces should fit accurately before the fascia is applied, but the joint should not be too loose. Only sufficient bone must be removed to give free motion. If too much of the ends of the bones is removed, a flail joint will result, giving the operation no advantage over an excision. When this mortising is completed, the fascial flap is dissected from the leg (Fig. 8). An incision is made on the outer side of the thigh, a little below the middle, extending down to the fascia lata. After a flap of fascia 5 to 7 inches long by 4 to 5 inches wide is dissected out, the wound is closed.

Fig. 32. Case 21. I. L. End-result. Above, voluntary flexion; below, voluntary extension.

This fascia, which is free from all fat, is placed about the newly fashioned humeral condyles and attached anteriorly to the capsule (Fig. 9) and posteriorly to the periosteum of the lower end of the shaft of the humerus with interrupted chromic catgut sutures No. 2. Chromic catgut No. 2 is then wound twice loosely around the shaft just below the interrupted suture line.

The forearm is placed in apposition to the condyles. Two drill holes are then made in the olecranon process and two others opposite

Fig. 33. Case 24. F. A. End-result. At left, voluntary flexion; at right, voluntary extension.

them in the shaft of the ulna. Through these, kangaroo tendon is passed and tied. The inner layer is now sutured with chromic catgut No. 2 and the skin and fascia with plain catgut No. 2. Dry sterile dressings are applied and the arm put up in plaster beyond a right angle.

AFTER-TREATMENT

If there is no evidence of infection, the cast should remain on for a week. It is then split and the dressing changed. If there is a persistent temperature, a window should be cut in the cast and the wound inspected.

Passive motions are begun in about 10 days, if normal healing has taken place. The arm is always kept above a right angle. After 3 weeks, gentle massage is applied. Baking is begun in 6 weeks, three or four times a week.

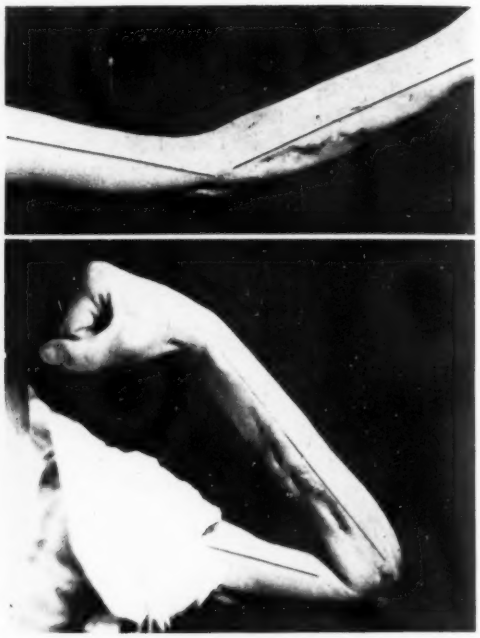


Fig. 34. Case 25. F. D. End-result. Below, voluntary flexion; above, voluntary extension.

The ultimate success in these cases depends very largely on the after-treatment. The patients should be under observation for a long period of time. Frequent X-rays should be taken so that we may follow the bony changes in the joint. If motion begins to shut down, the arm should be manipulated under an anæsthetic and the elbow put up in acute

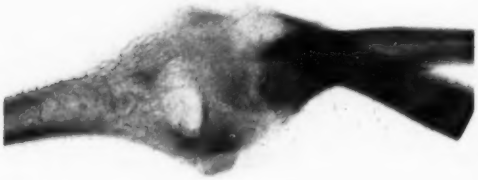


Fig. 35. Case 26. S. S. Roentgenogram showing ankylosis before arthroplasty.

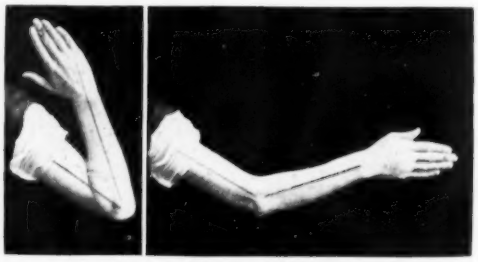


Fig. 36. Case 26. S. S. End-result. At left, voluntary flexion; at right, voluntary extension.

flexion. Occasionally, motion becomes limited, due to an exuberant growth of new bone. In this case, a secondary operation should be done to remove this, but it should not be undertaken for at least 3 months after the original operation.

Case 1. F. P., December, 1909, fell on her elbow in March, 1908. The injury was treated as a sprain and the elbow put up in a splint. She recovered except for a slight stiffness and pain, but as time went on the motion became less. Later, she was under observation for 6 weeks in the out-patient department.

On November 18, 1908, an attempt was made to gain motion by removing as much exuberant bone as possible. Following the operation, the patient suffered from a Volkmann's paralysis. She made a splendid recovery from this paralysis but, unfortunately, on account of the sensitiveness of the elbow, there was not so much motion as before the operation. An arthroplasty was therefore advised. This I did in December, 1909, using the Murphy method.

The circulation of the skin above the original site of the flaps became somewhat diminished and there was a small amount of sloughing. The wound was dressed each day and on the fifth day daily attempts at motion were begun. In the course of a month, massage and baking were again taken up and continued until May, 1910.

The patient was last seen April 11, 1919. She had at this time motion from 45 to 125 degrees and no tenderness. Except for extension, the result was perfect. Previous to her marriage, she had used her arm daily in her employment as a stenographer.

Case 2. M. R. for 13 years had had attacks of rheumatism affecting the ankles, elbows, and knees. The physical examination was negative except for the joints. Both knees were slightly flexed and the right one was ankylosed showing scars on either side. The right ankle showed some contraction of the tendo achillis. The left elbow showed good motion except for 10 degrees limitation in extension; the right was ankylosed at 125 degrees.

Fig. 37. Case 27. N. B. Roentgenogram showing position of ankylosis before arthroplasty.

The patient was admitted to the orthopedic service of the Carney Hospital, September 6, 1910, where very slight improvement took place in her knees and feet under conservative treatment. In October, on account of the swelling and bogginess of the left knee, an arthrotomy was advised. This was done October 19. Daily manipulations were begun on the fifth day, and an uneventful recovery took place as regards the knee.

As the elbow was stiff and in an ungainly position, operation on this joint was advised. On November 5, 1910, an arthroplasty by the Murphy method was done on this joint.

November 10, the right hand was considerably swollen and painful, for which pressure and hot fomentations were applied. The skin on the upper part of the arm became somewhat necrotic from poor circulation and later sloughed.

November 30, passive motion was begun and repeated daily. The first attempt was made at motion, when 30 degrees were attained. Following this, progress was continuous and a gradual gain in motion was made. Later, massage was ordered for the hand, forearm, and shoulder.

January 11, 1911, about 30 to 40 degrees of motion in flexion and extension were obtained. The wound showed heavy granulation tissue. A week later she

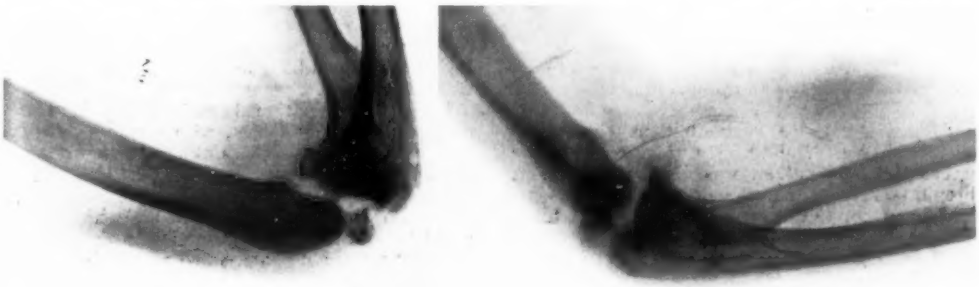


Fig. 38. Case 27. N. B. End-result. At left, voluntary flexion; at right, voluntary extension.

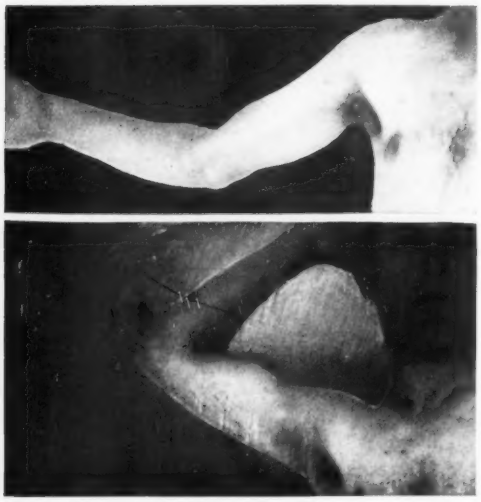


Fig. 39. Case 28. W. M. End-result. Below, voluntary flexion; above, voluntary extension.

was discharged from the hospital. Dressings were to be done at home.

February 28, she was readmitted to the hospital for manipulation when normal motion was obtained.

March 13, the patient was discharged to continue massage and manipulation at home. Since this time, she has been seen in the out-patient department. There is practically no lateral mobility and the end-result is perfect function.

Case 3. R. T. In this case, ankylosis had followed a fracture 5 years previously. A year and a half before, an attempt was made at the Massachusetts General Hospital to gain motion by open operation, followed by Zander treatment and baking. At the time when I first saw her, there was no pain in the arm but the stiffness was increasing. For this, an arthroplasty was advised.

On July 26, 1911, I did an arthroplasty by the Murphy method. The ether recovery was good but the patient showed a mild paralysis of the ulnar nerve which disappeared 2 days later.

The wound was dressed daily, when it showed considerable discharge of fat necrosis, but no infection was apparent. The arm was very sensitive and painful on movement. The motor power of the third and fourth fingers was restored but sensation was still slightly impaired. Following this, recovery was uneventful, and patient was discharged from the hospital on August 19 to report to my office.

October 24, the patient was readmitted to the Carney Hospital for manipulation, which was done the following day. She was discharged on October 26 with the arm in acute flexion.

February 18, 1914, the patient could extend the elbow to 165 degrees and flex to 25 degrees. The patient plays the piano and does all her housework.

Case 4. W.D. was referred to me by Dr. A. W. Shea of Nashua, New Hampshire, and was operated upon before the New Hampshire Surgical Club. On March 25, 1911, he received a contused wound of the left thumb, which became septic, requiring, 1 week later, his entrance to the hospital, as sepsis had become general. Five incisions were made in the left hand, two in the left wrist, one close to the left elbow-joint, and one in the left hip. All had drains put in. A student in the hospital opened a swelling near the right elbow and cut into the joint. At the end of 21 weeks the patient was discharged from the hospital with bony ankylosis of the right elbow with but a few degrees of motion in the left elbow. Both joints were slightly flexed. The left wrist had a sinus which still drained a little and he had little motion in the fingers, being unable to flex them to a right angle with the palm of the hand. He was unable to feed himself or to touch his head with either hand. He entered St. Joseph's Hospital a few weeks later and I did an arthroplasty on his right elbow, in March, 1912, using a flap of fascia lata to interpose. A hard bony ankylosis was found. The skin was closed with silkworm-gut and a voluminous dressing applied with the arm at a right angle. Arm and forearm were placed on pillows with heavy dressings but no splint. Passive motion was begun on the fifth day. Primary union took place in the wounds of the elbow and thigh. Passive motions were continued and increased, but at the end of 6 weeks it was found that the patient could not use either biceps or triceps muscles and he had lost all power from long disuse. However, after several weeks he educated the muscles by counting and attempting contraction at the same time and finally was able to flex the forearm himself, since which time improvement has continued.

He has now full motion in flexion, extension, and rotation and is able to feed himself and to do chores about the house and put on his own clothes. Previous to operation, he was entirely helpless, unable to care for himself in any way.

Case 5. E. M. Two years before, the patient became ill with infectious arthritis which at first affected the knees. The trouble started slowly with general poor health. There was no history of a neisserian infection but the patient was very much constipated and suffered more or less from tonsillitis. Later, the elbows became painful and could not be straightened out.

Physical examination showed a thickening of the capsule of the left elbow, with about 35 degrees limitation in motion. The left knee showed extension to within fifteen degrees of straight. The patient walked with a marked limp and flexed knees. General treatment was prescribed, with forcible extension of the knees. As motion in the arm had shut down leaving it ankylosed at 100 degrees, an arthroplasty on this joint was advised.

February 25, 1913, I did an arthroplasty, using my fascia lata method.

March 24, the arm showed no swelling. There was little pain and the patient's general condition was fair. There was about 15 degrees motion. Gentle manipulation was ordered.

December, 16, the wound had healed by first intention; supination was three-quarters normal, extension was to 170 degrees and flexion to 10 to 15 degrees beyond a right angle. The patient could reach the opposite shoulder with the thumb with ease but could not dress the lower part of the hair. The muscular power was as good as in the right arm. To gain more motion, a forcible manipulation was advised.

December 29, under ether, extension to within five degrees of straight was obtained and flexion to 45 degrees.

January 26, 1914, examination of the arm showed no lateral mobility and no crunching crepitation. Mobility was from 150 degrees to 70 degrees.

December 10, 1914, the patient showed voluntary motion from 55 degrees to 145 degrees.

Case 6. M. B. was admitted to the House of Mercy Hospital, Pittsfield, June 15, 1913, suffering from a bony ankylosis of the right elbow. Two days later, I did my usual arthroplasty putting up the arm in plaster in full extension. Recovery was uneventful. The arm was twice manipulated under ether, on July 29 and on August 13 to gain further flexion. She was discharged September 24, wearing her arm in a short sling. This was a clinic case and I have been unable to obtain any later data on the case.

Case 7. E. S. was admitted to the Carney Hospital, August 11, 1913, for immobility of the right elbow and right knee. Six years previously, the patient had had an acute illness accompanied by fever and pain and swelling in the joints, for which she was treated in her home, without relief. At the end of 8 months, the pain and swelling had disappeared from her left shoulder and elbow so that she was able to feed herself, but she remained in bed for 12 months and after this was in a wheel-chair for 2 years. The symptoms continued to subside on the left side until at the end of the third year, she was able to get about with a cane. As the fever continued to subside and the pain and swelling disappeared, fairly good motion returned to all the joints except the right elbow and the right knee, in which pain and stiffness continued at the end of the fourth year and no motion was possible. This condition continued up to the time of admission. August 14, roentgenoscopy revealed an ankylosis of the elbow-joint and of the patella to the femur.

August 20, I did an arthroplasty of the right elbow, using a flap of fascia lata. A light plaster cast was applied. Following the operation, the patient made a good ether recovery. There was slight pain in the elbow.

August 27, the cast was split for dressing.

September 1, the wound had healed by first intention except for a slight discharge on the upper border. September 4, daily manipulation of the elbow was ordered.

September 10, the arm could be extended completely and flexed to 15 degrees beyond a right angle.

September 15, traction was applied for flexing and extending the arm.

October 1, active motion was possible.

October 15, I manipulated the arm under ethyl chlorid.

She was discharged from the hospital. May 15, 1919, 5 years and 10 months after operation, she writes "the arm is doing excellent work." Photographs taken at this time show practically full extension and flexion.

Case 8. W. D. The previous history of this case is given under Case 4. After the arthroplasty on the right elbow, the patient requested that a similar operation be done on the other elbow. The roentgenogram showed a bony ankylosis at 90 degrees. On January 31, 1914, I did an arthroplasty on the left elbow-joint, using the same method applied in the case of the right elbow. The end-result was a stabile useful elbow, with motion from 60 to 160 degrees.

Case 9. R. B. was seen in consultation March, 1914, suffering from partial loss of function of the left elbow, as the result of an old fracture of the olecranon and external condyle and was unable to extend the elbow beyond a right angle, with supination limited one-fourth. An arthroplasty was advised.

This was done at the Carney Hospital on March 17, 1914. The usual technique was used and the arm put up in a sterile dressing in extension. The boy made a good ether recovery, slept well, and suffered no pain.

The wound remained clear until the 23d when it appeared reddened and showed some discharge. The following day, the axillary glands were tender to the touch and the hand showed some œdema. Hot poultices were applied.

By the 27th, the pain was relieved and the glands were not palpable. The wound was clean. Two silkworm-gut sutures were applied to prevent the spreading of the wound.

On March 31, a plaster cast was applied from axilla to finger tips in 15 degrees flexion and one-half supination.

On April 1, manipulations were begun and continued daily.

On April 11, the patient showed full pronation and supination but only about 45 degrees flexion.

On April 18, a splint was applied to increase flexion.

On April 23, I gained 45 degrees flexion, putting the elbow up in plaster in acute flexion. This cast was split on April 29. On May 1, the arm was put up in plaster at 10 degrees' flexion. A window was cut in the plaster and the wound dressed. The patient was then discharged to have the arm dressed by his family doctor. I have been unable to obtain later reports on this case.

Case 10. E. E. had fractured his elbow 8 years before. He entered the Massachusetts General Hospital 11 days later. The roentgenogram showed a supracondylar fracture, probably epiphyseal, with a

good deal of displacement of the lower fragment. A closed reduction was attempted under ether and the elbow put up in plaster with only a little flexion. Seven weeks later, he re-entered the hospital. At this time, the X-ray showed a very faulty position with some ankylosis of the joint. An osteotomy of the joint was done and the arm elevated. The arm was put up at an angle of about 150 degrees and the patient discharged to the convalescent home.

Three weeks later, he re-entered the hospital. At this time the elbow was swollen and very tender. The elbow was incised and the abscess drained and hot soaks ordered. He was discharged a month later.

Two months later, he re-entered the hospital for persistent sinuses in the arm, which were incised and drained. A week later, he was discharged relieved.

The patient entered the Carney Hospital November 28, 1913. At this time there was considerable atrophy of the arm and forearm. The elbow was ankylosed at 85 degrees and showed the scars of the previous operations. Ether manipulation was done on the wrist and later on the elbow.

Later, December 24, 1913, an excision of the semilunar, scaphoid, and pisiform was done.

On January 14, 1914, I did an arthroplasty on the elbow. At the time of the operation, the ulnar nerve was not found in its usual bed, probably having undergone degeneration. No bony landmark could be made out.

He made a good recovery from the operation. The wound remained clean but showed a slight serous exudate. Later, the wound showed a slight slough.

The elbow was manipulated on February 20, gaining motion to a right angle.

Five weeks later he was discharged to be treated by his family physician.

This case was not seen again until recently, when he showed a fibrous re-ankylosis with marked muscular atrophy.

CASE 11. E. S. sustained a fracture of the right elbow on October 4, 1913, as the result of a fall of 42 feet. The roentgenogram showed a transverse fracture of both condyles with the radial head dislocated laterally and anteriorly.

Physical examination was negative except for the right arm. The shoulder appeared normal. The elbow was held at 150 degrees extension with less than 3 degrees motion. Supination was limited one-fourth. The wrist showed a Colles fracture unreduced. Flexion and extension were both one-half normal. Eversion was limited three-quarters and inversion four-fifths.

On March 25, 1914, I did an arthroplasty on the right elbow, using a flap of fascia from the thigh. When the joint cavity was opened, it was found that the synovial tissue was hypertrophied and there was much fibrous callus formation infiltrating the articular surfaces. A transverse fracture of both condyles was noted. The head of the radius was impacted and was surrounded by callus formation.

Five-eighths of an inch of the condyles was sawed off square at right angles to the shaft of the humerus. The joint surfaces were smoothed off and the operation completed according to my usual method. The arm was put up in plaster in an extended position. The patient made a good ether recovery but suffered considerably from pain, for which morphia was ordered, and the following day the arm was put up in suspension. He continued to suffer considerable pain for four days, after which the pain abated.

On March 29, the wound was dressed and was found clean with some serous discharge.

March 30, the cast was split and a voluminous dressing applied with splints to the forearm.

March 31, the patient was seen in consultation by Dr. Courtney, who reported a tourniquet paralysis and advised electricity and massage.

April 1, the wound was dressed and found clean and healing by second intention.

April 5, the patient was out of bed and walking about the ward. When dressed, the wound was found clean.

April 10, the wound was dressed. The motion in the elbow was good with good supination and about 45 degrees flexion. A nerve report was ordered.

April 15, the nerves were reported responding to the faradic current. The prognosis was considered good. Massage was advised.

April 18, the patient was discharged from the hospital to report daily at my office.

November 30, the patient re-entered the hospital for operative interference in an attempt to gain increased motion. Both bones of the forearm had dislocated backward and the head of the radius was very much enlarged. Motion was from 150 degrees to 50 degrees with the carrying angle markedly increased.

On December 2, after the usual preparation, a 4-inch incision was made over the external condyle. The removal of the enlarged head of the radius caused a marked increase in motion but the posterior dislocation was not improved. The internal condyle was chiseled loose and removed through a small incision over the fragment. After the end of the humerus was smoothed as much as possible with a rasp, the wound was closed and a cast applied with the arm at right angles. A good ether recovery followed.

After the operation, the patient suffered considerably and showed some swelling of the arm. On the fourth day, the cast was split, when the patient experienced relief.

On the 7th, the patient was comfortable and out of bed. The following day he was discharged to report to my office. The end-result shows nearly normal range of motion with a stabile, useful joint.

On October 29, 1920, he writes: "I can crank a Ford. I can do anything that I ever could. My work is driving and repairing automobiles and I have had to change a 38-7 tire on the road, which requires the use of two good arms."

CASE 12. M. S. had suffered from a chronic arthritis, probably a neisserian infection, affecting both wrists, the left knee, and the right elbow. The

trouble had begun 4 years before and was gradually getting worse until she was unable to work. The left knee showed thickening and slight heat. It was held in 45 degrees permanent flexion and showed only 10 degrees motion. Her left wrist was ankylosed. The right elbow was ankylosed at right angles and was painful at one-half supination.

The patient entered the House of Mercy Hospital on June 18, 1914, where an arthrotomy followed by oil injections was done on the knee and an arthroplasty on the elbow. Four months after arthroplasty, the patient showed a range of motion from 60 to 140 degrees and a stabile, useful joint.

Case 13. M. F. had a severe polyarthritis when 6 years old. At this time, she was under treatment at the Holyoke City Hospital for 10 weeks, receiving general treatment from which she experienced temporary relief. Since then, she has suffered recurrent attacks of acute arthritis.

When she entered the Carney Hospital on April 23, 1914, physical examination showed an involvement of her elbows, wrists, fingers, knees, and ankles in the infectious process. Motion was limited and the joints were swollen and contained a small amount of fluid. The elbows were ankylosed at 125 degrees. Consultation was held with the medical, surgical, and laryngological staffs, whose reports were negative, except in regard to the tonsils. Following their removal on May 16, she showed marked improvement in the hands and feet under conservative orthopedic treatment.

On June 10, her wrists, ankles, and knees were manipulated under ether. From this operation, she made an uneventful recovery.

As her elbows were ankylosed, an arthroplasty was advised on the right elbow. This I did on July 1 by my usual method. She made an uneventful recovery and on July 26 showed motion from 50 degrees to almost normal extension. Flexion later increased to within 15 degrees of normal.

On August 12, I manipulated the arm and put it up well beyond a right angle. On August 19, the elbow could be manipulated without force to beyond a right angle, with force to within 5 degrees of full. Following this, however, motion gradually shut down and the end-result was re-ankylosis. I believe that this result is to be expected in children, on account of the impossibility of removing sufficient bone without injury to the epiphyses.

Case 14. A. M. had suffered from infectious arthritis for 10 years. Her fingers, knees, and elbows had become stiff.

Physical examination was negative, except for the joints. The right elbow was ankylosed at 90 degrees with about 30 degrees motion. The wrists were ankylosed in slight flexion. Previous to the arthroplasty, her feet and knees were manipulated.

On November 14, I did an arthroplasty, inserting a flap of fascia lata. Convalescence was uneventful.

On February 10, I manipulated the elbow under ether, holding the elbow in acute flexion with bands of adhesive. She was discharged from the hospital on April 2 with motion from 45 to 100 degrees.

Case 15. L. P. I saw the patient for the first time July 10, 1914. The trouble had begun November 23, 1912, when she was confined in bed with a temperature of 102° and swelling of the wrists and ankles. It had progressed ever since in spite of orthopedic and other treatment.

Physical examination showed marked involvement of all the joints of the arms and legs with ankylosis and more or less pain and swelling. The left wrist was ankylosed at 35 degrees radial adduction and the left shoulder showed a bursitis. The left elbow showed a few degrees motion and was held rigidly at about 135 degrees extension.

The patient was advised to have the shoulder manipulated and put up in plaster and to have the deformity of the wrist corrected. For the elbow, an arthroplasty was advised.

On July 10, I did an ether manipulation of the hips, knees, and feet.

January 13, 1915, an arthroplasty was performed on the left elbow. The olecranon was found ankylosed to the humerus. Both humerus and ulna showed a large amount of bone atrophy.

On October 13, I operated on the wrist for ankylosis. I excised the heads of the first phalangeal joints of the four fingers besides the distal metacarpal head of the thumb and fourth finger.

On February 6, 1916, I did an excision of the shoulder.

The latest report on this case is July 23, 1919, at which time flexion was perfect; when standing or sitting, complete extension is possible. The action of the elbow, however, below a right angle is weak, due to muscular atrophy.

Case 16. G. F. The trouble began 8 years before with an infectious arthritis affecting the fingers of the right hand. Later, she had other attacks involving the other hand, the feet, ankles, and knees. About a year before she entered the hospital, she was confined to her bed for 8 weeks with an attack involving the elbows, hands, and ankles. Subsequent to this, the mobility in her hands and elbows had diminished. She entered the Carney Hospital on December 27, 1913, for relief of this condition.

Physical examination at this time showed marked involvement in the arthritic process of the elbows, fingers, ankles, and toes. The right elbow was ankylosed at 155 degrees. The left elbow showed motion from 160 degrees extension to 45 degrees flexion.

The patient received general treatment and was referred to the surgical department for an ileosigmoidostomy. She left the hospital relieved following this operation.

In January, 1915, she re-entered the hospital for relief of the stiffness of her joints. Since the ileosigmoidostomy, her general health has improved. Her joint condition, however, has remained unchanged.

Physical examination showed the right elbow permanently ankylosed, the left ankylosed at 90 degrees with 5 degrees motion.

On January 20, 1915, I did my usual arthroplasty on the right elbow. She made a normal recovery and left the hospital with a good amount of motion.

After she left the hospital, she had another acute attack of arthritis which affected this joint. Gradually, motion became more painful and shut down. For this condition, she re-entered the Carney Hospital. The X-ray showed anteriorly the development of new bone. A secondary operation was done at which the head of the radius was removed as well as the exuberant bony tissue.

CASE 17. I. H. had fallen on her elbow 4 months before she entered the hospital. She had suffered considerably from pain and was unable to use her arm. At this time, I manipulated her elbow under ether and later manipulated it every 2 weeks in the Carney out-patient. On account of the limitation in motion, an arthroplasty was advised.

She entered the Carney Hospital on June 22, 1915. At this time, the elbow was slightly tender and motion was limited to forty degrees. There was no pain but the joint was somewhat enlarged and the bones felt rough. The roentgenogram showed an old fracture of the lower end of the humerus.

On June 23, I did an arthroplasty of the elbow-joint, using a free flap of fascia lata, after which the patient made a good ether recovery. The following day, the plaster was trimmed about the fingers. The fever and swelling of the hand continued for several days until, on the 28th, the cast was bivalved, when the temperature dropped and the œdema disappeared.

On July 3, the patient was up in a chair. On the 6th, the dressing showed a slight superficial sepsis. The motion of the arm was very much increased. She was discharged from the hospital on July 15, to report to the out-patient department. Following this, there was a gradual return of motion.

In June, 1919, 3 years after the operation, she showed a range of motion from 37 to 125 degrees.

CASE 18. D. S. While playing basket ball, the patient had been pushed against the wall, injuring the right elbow. He suffered a good deal of acute pain immediately following this and soreness had persisted for several weeks. The elbow had gradually become stiff. Twelve months before this, D. S. had had an acute condition in the elbow, when it was hot and painful, but quieted down quickly.

Physical examination showed the right arm held in about 105 degrees flexion. About one-fourth pronation was allowed and supination was limited one-half. The patient's grip was good and he had apparently full use of the fingers and hand. There was very slight capsular thickening and the fossæ on either side of the olecranon were not as sharp as normal. The musculature of the arm was good. Sudden jerks in flexion and extension were painful.

Arthroplasty was advised. This was done by my usual method at the House of Mercy Hospital, Pittsfield, September 23, 1915.

The patient was last seen 2 years after the operation. He has been working with the General Electric Company and has been admitted to the National Guard. He states that in damp weather he has a little aching pain and cannot do heavy lifting. He can dress himself. In October, 1917, while playing a game, his arm was strained and something snapped, but he was able to keep on playing. The fingers got a little stiff afterward with pain up the arm. The weakness and inability to use the arm lasted 4 weeks but was followed by perfect recovery.

The arm at this time showed extension to 125 degrees and flexion to 20 degrees, pronation one-half. Musculature was good. He shows a perfect functional result.

CASE 19. J. T. One year before the arthroplasty, his right arm had been severely burned while he was at work in a paper mill. The burn had become septic, resulting in marked contraction of the scar tissue for which an extensive skin graft had been done with very good result. His elbow, however, had remained stiff.

Physical examination was negative except for the right arm. The scar tissue extended from the fingers to the axilla on both anterior and posterior surfaces. The thumb was abducted one-half and the fingers held in hyperextension. They could, however, be flexed.

On October 4, 1915, I operated upon the elbow doing an arthroplasty with a flap of free fascia. At operation, the ankylosis was found to be fibrous.

The patient made a good recovery from the ether. The wound was dressed on the second day when it was found clean, but the skin suggested a slough in the middle of the incision. He was discharged from the hospital on the 22d after an uneventful recovery.

Two months later, the elbow showed a range of motion from 45 to 140 degrees and was free from pain.

CASE 20. J. C. The right elbow had become stiff following an acute infection of the entire arm. Later, there had been a discharging sinus near the elbow-joint.

Physical examination was negative except for the right arm which showed some atrophy. All motions of the shoulder were normal. The elbow was solidly ankylosed at 165 degrees. Motion of the hand was limited. The X-rays showed a bony ankylosis of the elbow-joint.

On February 27, 1917, I did an arthroplasty by my usual method. This case was unusual in that the remodeling was very difficult. Ordinarily, after the olecranon has been sawed through, you can break open the joint or, at least, there is soft bone that is readily sawed through. But in this case, the joint was solidly ankylosed and every vestige of the joint had disappeared.

Following the operation, the wound showed some bloody oozing. On March 5, a window was cut in the cast and the wound was found healed and clean. The patient was out of bed on the 10th and 7 days later was discharged from the hospital. Baking and

massage were continued. The end-result was a stable elbow with good function.

CASE 21. I. L. Her left elbow had become ankylosed as the result of an arthritis of 10 months' duration. When I first saw her, October 3, 1916, her elbow was very sensitive and painful. About 10 degrees motion was allowed in the joint which was held in 130 degrees extension. Supination was about one-third normal.

In spite of conservative treatment, the elbow continued to stiffen. As a roentgenogram taken February 17, 1917, showed a bony ankylosis, an arthroplasty was advised. This was done March 6, 1917, and was followed by an uneventful recovery.

Miss L. was last seen May 26, 1919. She stated that only occasionally did she have slight pain. Motion in the elbow was from 45 to 145 degrees and she had a stable, useful arm with no lateral mobility. Rotation was limited to 15 degrees in the mid-position. This loss of motion is apparently due to the enlargement of the head of the radius and its excision was advised.

CASE 22. C. M. had a complete bony ankylosis of the left elbow in 145 degrees extension. The condition had existed for 17 years, since the patient was 14 months old, when she had broken her arm. The X-ray showed a complete obliteration of the joint.

On August 23, 1917, I did an arthroplasty at St. Luke's Hospital, New Bedford. After an uneventful recovery, the patient was discharged a week later to report weekly to the out-patient department.

On September 6, the cast was split and the wound dressed. The patient had 15 degrees motion. Her arm was put up in a sling and she was asked to manipulate the arm and report again in 2 weeks.

September 27, she returned and was advised to continue treatment.

On October 11, the patient did not show much gain in motion. She admitted that she was not carrying out instructions regarding exercising the arm. She was advised to have an ether manipulation.

October 25, she reported at the hospital but again was found not to be carrying out instructions.

November 1, she showed a slight improvement. She was advised to increase her exercises.

November 8, she was referred to the hospital for an ether manipulation.

December 20, she was again advised to have the elbow forcibly manipulated.

January 3, 1918, an ether manipulation was done and the arm strapped up in 30 degrees flexion.

On January 10, the patient reported and was found to be doing well. She was asked to report each week.

When the patient reported again a week later, she was found to be again not following directions. A further manipulation was advised.

On January 31, she visited the clinic for the last time. Manipulation was again advised. Since this time, she has been seen several times by our social worker and urged to return for further treatment, but this she has steadily refused to do. She is working daily in a mill. When last seen, May 19, 1919, she stated that she felt the arm would have been all right if she had come again for operation, but was afraid of the pain and her mother did not want her to go again to the hospital. This case shows the necessity of the co-operation of the patient in the after-treatment.

CASE 23. M. R. fell on January 12, 1918, fracturing her elbow. Splints were applied at this time and remained on for 3 weeks. On March 7, an operative attempt was made at the Brockton Hospital to gain motion. I first saw Miss R. on June 4, 1918. At this time, her elbow was swollen and painful and allowed motion only from 155 to 160 degrees. It was held in permanent pronation with no motion in the radio-ulnar joint. There was a slight discharge.

A few weeks later she entered the Carney Hospital and on June 27 I manipulated the arm and applied a cast which was kept on 4 days. She was then discharged with her arm in a sling.

As the arm again stiffened, she re-entered the hospital February 10, 1919. At this time, her elbow was ankylosed at 90 degrees. On February 12, I did my usual arthroplasty. The soft tissue surrounding the joint presented a mass of scar tissue from which the ulnar nerve could not be isolated. The tissue through which the nerve must have run was therefore dissected back and retracted *en bloc*. The line of the old joint was discovered with difficulty.

The patient made a good ether recovery and was fairly comfortable the following day after some pain on the previous night. The cast was stained through by the discharge from the wound.

On February 14, a window was cut in the cast over the area of operation and a sterile alcohol dressing applied. The bloody discharge from the wound still continued on February 17. This condition remained unchanged until the 26th, when the wound showed some healing upon the outer side of the elbow. On the 28th, the discharge had decreased in amount but the dressing showed a slight amount of pus on the inner side.

On March 4, motion was possible from 80 to 105 degrees without pain.

On March 10, the arm was put up in a sling in as acute flexion as possible and daily manipulation of the fingers begun. The wound was still discharging.

On March 24, the discharge had decreased slightly in amount. The finger motions had increased.

On March 31, the condition was unchanged. Light massage was begun on the upper and lower arm. Dressings were continued twice a day.

On April 7, the arm was put up in a sling at about 70 degrees flexion. There was still a discharge. On April 14, there was some swelling back of the elbow-joint but no fluctuation was felt. The arm was kept quiet and the swelling subsided in a few days. The discharge gradually decreased, and on April 20 the patient was discharged to have the dressings done by her local doctor.

CASE 24. F. A. suffered on May 30, 1916, from a severe osteomyelitis of the left humerus. The arm

was incised at this time and a sequestrum removed. Since then, his general condition had improved but he had suffered from wrist-drop since the operation, and motion in the elbow had been lost.

When A. was referred to me, the arm showed a seven and one-half inch scar on the outer aspect. There were two sinuses which discharged creamy pus. The shoulder motions were one-half normal. The elbow was slightly thickened and showed local heat. It was ankylosed at 110 degrees with a few degrees motion. There was complete wrist-drop. X-ray showed a diffuse osteomyelitis involving the whole humerus with some evidence of sequestrum formation in the upper third. A subperiosteal resection of the shaft of the humerus was done. From this operation, he made a good convalescence.

On August 15, 1917, the arm showed the scar healed. There was apparently a total regeneration of the humerus. The shoulder showed 45 degrees motion in abduction with good anteroposterior movements. The elbow was ankylosed at 100 degrees with a few degrees motion. Supination was limited. His wrist was fitted with a hyperextension splint.

On June 4, 1918, as the elbow had not discharged for a year, an arthroplasty was advised. This was done July 24 at the Carney Hospital. The elbow was found ankylosed at 160 degrees. There was a musculospiral paralysis.

Convalescence was uneventful. On August 10, the cast was removed. On August 10, motion without discomfort was possible from 70 to 120 degrees. He had a slight rise of temperature on the 13th but this quickly dropped. He was discharged from the hospital on August 17 to have dressings done by his family physician and to report from time to time to my office.

September 7, he showed 15 degrees motion. On September 17, there was less motion. On October 24, motion had shut down to 8 degrees and a manipulation was advised. This was done on November 10, 1918, following which the elbow showed 10 degrees motion.

On November 5, 1919, I did a tendon transplantation for the relief of the musculospiral paralysis with excellent result.

However, as motion in the elbow was restricted, further operative interference was advised. For this, the patient entered the Brooks Hospital where, on July 7, I removed the head of the radius and three-quarters of an inch of the humerus.

He made a good recovery. On July 28, he had motion from 45 to 90 degrees. On August 25, he had motion from 75 to 135 degrees. On October 26, he showed motion from 40 degrees to 160 degrees.

Case 25. F. D. In 1910, the right elbow became swollen and tender. At this time an open operation was done on the joint. Six months later, another operation was done, after which the elbow drained for 4 years and he lost the entire use of the arm.

Physical examination showed marked atrophy of the muscles of the arm. There were numerus scars above and about the elbow. The elbow was ankylosed at 180 degrees. Finger and shoulder motions were normal.

On August 10, 1918, by my usual method, I did an arthroplasty on his elbow. He made a good recovery and had a normal convalescence. Two weeks later, he was discharged to have daily dressings done by his family doctor. Motion at this time was from 80 to 100 degrees without pain.

He reported at my office on August 30. At this time, the wound was not quite healed. The elbow showed 30 degrees motion. Following this, he was seen about every 6 weeks. On October 18, the wound was found healed. Motion gradually increased.

On December 9, 1919, he showed motion from 35 to 145 degrees with full supination. The elbow was stable with no lateral motion. He has no pain, works as a telegraph operator and "lifts anything."

Case 26. S. S. was first admitted to the Burbank Hospital, Fitchburg, December 5, 1917, with a subacute neisserian infection. Five years previously the right knee had become swollen, and remained so for 3 months. A month later, the right elbow became swollen and painful. At that time, she could bend the elbow but, as this caused pain, she did not do so. At the time of her admission, she could not bend the elbow nor lift the arm, and the elbow region was swollen and painful. The Wassermann test was positive. She remained in the hospital 38 days, receiving general treatment and was discharged relieved.

She returned to the out-patient department, July 1, 1918. The arm was then put up in plaster from wrist to shoulder to remain on 2 months. She was told that her elbow would probably become stiff and would require an arthroplasty later.

On January 9, 1919, the patient was advised to have an arthroplasty done as her elbow had become stiff. Following the operation on February 6 she had an uneventful recovery. The cast was removed in 2 weeks, after which passive motion was begun. She was discharged March 18, 1919.

When last seen, April 3, 1919, she had a range of motion from 45 to 135 degrees.

Case 27. N. B. was admitted to the House of Mercy Hospital, Pittsfield, on March 4, 1919, for the relief of an ankylosis of 4 months' duration, the result of an infectious arthritis. There was marked atrophy of the left deltoid but no pain nor tenderness in the shoulder-joint and no limitation of motion. The left elbow was ankylosed at 150 degrees. She remained at this time in the hospital for a month under conservative treatment, then left the hospital unrelieved and was advised to return later for operative interference.

On June 24, she re-entered the hospital. At this time, the elbow was ankylosed at 150 degrees. I did my usual arthroplasty and obtained a very good immediate result. The convalescence was uneventful but the patient did not co-operate in the after-treatment, spoiling what would otherwise have been an excellent result.

On September 16, following manipulation, she gained voluntary extension to 150 degrees. She returned to the outpatient department for massage and manipulation until December, 1919. At this time, she had motion from 75 to 120 degrees and a useful, stable arm.

Case 28. W. M. had fractured his olecranon as the result of a fall. Following an open operation in which the olecranon was fastened in place with silver wire, the elbow gave him no further trouble until a year later following a second injury. When moving a heavy box, a second box had fallen and hit him on the elbow. Two weeks later, when he reported to the hospital, he was in great pain and showed a discharging sinus from which a piece of wire which was protruding was easily removed. Free drainage was established and later the arm was twice curetted. He was discharged March 21 after a tempestuous illness, to report to the out-patient department for dressings. In July, the wounds had healed and the patient was discharged to return in 6 months for an arthroplasty.

This I did on July 9, 1919, and on his discharge from the hospital on September 4, he was able to flex and rotate his arm voluntarily. He is still undergoing treatment and manipulation, baking, and massage. On October 18, 1919, he had voluntary motion from 158 to 105 degrees. On October 30, 1920, he had voluntary motion from 60 degrees to 135 degrees.

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SECTION OF THE ANTEROLATERAL TRACT OF THE CORD FOR THE RELIEF OF INTRACTABLE PAIN DUE TO SPINAL CORD LESIONS[1]

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THE problem of relieving the pain arising from lesions involving the spinal cord or peripheral nervous system may try the resources of physicians and surgeons alike. The remedy for these distressing conditions is therapeutic or such radical procedures as section of the cord, complete or partial; division of the posterior spinal roots; division of the posterior columns of the cord; section of the pain-conducting tracts in the cord above the level of the disease and extradural operations on spinal roots or ganglia.

What does medicine offer? Therapeutic measures, consisting chiefly of the administration of drugs of the opium group, usually prove unsatisfactory. The condition of the patient becomes pitiable. Deriving only temporary relief, he either becomes addicted to the use of morphine or despairing of relief may attempt suicide.

What does surgery offer? Thanks to the neurologist several measures have been advocated. Although section of the cord has been suggested as a last resort in lesions producing unbearable pain, one can hardly conceive such a measure actually being carried out with all the outcome which a complete paralysis would bring. Division of the posterior roots of the spinal cord for the relief of pain was first suggested by Dana in 1888, and Abbe was the first to report the operation. Since this time numerous root resections are on record and although the operation would appear theoretically sound many failures to attain the desired result have been reported. In 1900, Mingazzini proposed the operation for gastric crises and lancinating pains of tabes. But it was not until 1908 that Foerster first reported the operation for this disease. The result of operation in a large series of these cases has not been entirely satisfactory. "In 1910 A. Schuller suggested that as a substitute operation partial division of the spinal cord might be employed, instead of section of the posterior roots for spasticity either alone or with the direct cerebellar tract; the anterolateral column might be cut for gastric crises. He reported no cases in which this operation was performed and he advised it for these two conditions."

A notable contribution to this subject was made by Spiller in 1912. He proposed employing the method of dividing the anterolateral tract of the cord for the relief of persistent pain of organic origin independent of gastric crises, and with Martin published the result of the first case illustrating this procedure. The operation was performed by Martin, January 19, 1911. Since then the operation has been performed by Beer, Foerster, Elsberg, and Frazier who recently published his results in 6 cases.

A brief abstract of the recorded cases are here included.

Spiller and Martin. J. Am. M. Ass., 1912, lviii, 1489. Patient had an inoperable tumor of the lower part of the spinal cord from which he suffered severe pain in both legs for 2 years previous to operation. At the suggestion of Spiller a division of each anterolateral tract was made by Martin, January 19, 1911. The laminæ and spinous processes of the sixth, seventh, and eighth thoracic vertebræ were removed. Two months later it was noted that the operation seemed to have been successful in diminishing the pain.

Beer. J. Am. M. Ass., 1913, lx, 267. Metastatic carcinoma in pelvis originating from the cervix uteri, which was removed 15 months previously. Severe pain in right leg which caused the patient to draw up the leg. A stovaine injection into the spinal canal was made with complete temporary relief of all pain. He advises this procedure on the ground that if the injection does not produce relief, the operation is contra-indicated for self-evident reasons. On July 2, 1912, a laminectomy with removal of the ninth and tenth thoracic laminæ was made and the left anterolateral column was sectioned. Twelve days after operation the patient was up walking about, all pain in the right lower extremity was gone, and no vestige of it was felt since operation. Some pain developed later in left side and back but to day of her death patient was free from pain in right side.

[1] Read before the Western Surgical Association, Los Angeles, December 3-4, 1920.

Foerster. Surgery of the Spinal Column by Frazier, p. 910. At Foerster's suggestion Tietze performed a section of the lateral column on a patient who had previously had a root resection for gastric crises in which posterior roots from the sixth to twelfth thoracic had been cut. Pains which became unbearable appeared in the left leg. An attempt to section the lumbar roots was found impossible because of adhesions, and section of the anterolateral columns was decided upon. Following this the pain entirely disappeared.

Elsberg. Diseases of the Spinal Cord and Its Membranes by Elsberg, p. 164. Reference to, but no abstract of, the operation is given.

Frazier. Arch. Neurol. & Psych., iv, 137.

CASE 1. The patient had an inoperable sarcoma of the spine at the level of the second and third lumbar vertebræ. Suffering was intense and uncontrolled by morphine. Chordotomy was employed with section of the anterolateral column, right and left, at the level of the first lumbar segment. This resulted in total loss of thermal and pain sensation.

CASE 2. The patient had a gunshot wound of the spine with intense pain in the left lower extremity. Four grains of morphine a day were given with only partial relief. Unilateral chordotomy was performed and resulted in complete cessation of pain. There had been no recurrence at the last observation, 12 months later.

CASE 3. The patient had carcinoma of the rectum, with pain in the rectum, buttock, and thighs. Colostomy and section of the anterolateral column, left and right, were performed. Complete loss of thermal and pain sense on one side only resulted. Radiumtherapy was employed for the carcinoma. Four years later the patient reported himself free from discomfort; presumptive recovery.

CASE 4. The patient had an inoperable sarcoma of the thigh with pelvic metastasis and insufferable pain in the gluteal region. The anterolateral columns of the cord were sectioned with relief from pain from the time of the operation until the patient's death, months later.

CASE 5. The patient had received a gunshot wound of the spine, and suffered pain in both lower extremities. Chordotomy was performed with loss of pain and temperature sense.

CASE 6. The patient had received a shell wound of the pelvis with injury to the sciatic nerve. He had had intense unbearable pain in the thigh and foot for two and a half years, unrelieved and unabated. The anterolateral columns were sectioned with absolute relief. There was recurrence of pain much more moderate, several months later.

SELECTION OF THE SEGMENT OF CORD FOR OPERATION

In the language of Frazier, "the question of segmental selection is a matter of some concern. We assume that the lesion does not involve the upper extremity. Manifestly, the section could not be made sufficiently high, that is, several segments above the origin of the brachial plexus, with any degree of safety. We assume that the lesion is in the pelvis or involves the spinal column not above the lesion so as to ensure the crossing of all afferent tracts and to allow for the extension of the growth upward, it would be well to add two or three segments. So much for the physiological or anatomical grounds. From the practical or technical point of view, I have selected the sixth thoracic segment as the most convenient for all lesions not higher than the ninth or tenth segments." In his book on *Surgery of the Spinal Cord*, Frazier suggests that the fourth, fifth, or sixth thoracic segment should be selected as this level would be appropriate not only for the relief of pain in the lower extremity but for the relief of gastric crises.

DESCRIPTION OF THE OPERATION

In this operation as in all surgical procedures a knowledge of the anatomy and physiology of the spinal cord is essential. The cord is exposed in the region of the fourth, fifth, or sixth thoracic segments by the usual laminectomy. Removal of two laminæ is as a rule sufficient for the proper exposure of the cord. The dura having been opened the dentate ligament is identified, grasped with a mosquito forceps, and severed from the dura. Traction on this ligament will rotate the cord so that the anterolateral tract may be readily exposed. A small von Graefe knife with its back toward the dentate ligament is inserted just in front of the ligament and passed to a depth of 2.5 millimeters and brought out behind the origin of the anterior roots, making an incision approximately 2.5 millimeters deep by 3 millimeters wide. The section may be unilateral or bilateral depending on the nature of the lesions. Bleeding is usually slight following the section. A stovaine block may be employed previous to the section by placing a pledget of cotton saturated with 0.4 stovaine solution on the cord above the level of the section. Following the section the dura is closed and the laminectomy wound sutured in layers.

POSTOPERATIVE TREATMENT

Following the operation careful nursing must be carried out as the patient has lost both pain and temperature sense if the operation has been correctly done, and the patient must also be warned of this particular. In all of my cases a hyperæsthetic zone at the level of the divided segment has been noticed. Pain at this level may be so severe as to require an opiate to relieve it.

The phenomena of bowel distention, constipation, bladder tenesmus with retention, symptoms not unusual in laminectomies, were present in all my cases. These symptoms, however, disappeared within a short time.

Only a brief summary of my operations is here given as a more extensive neurological report will be made later.

CASE 1. Referred by Dr. Romeiser of the Neurological Service, St. Louis City Hospital. W. J., age 34, a poorly developed and nourished man, had suffered from tabes for past 6 years. He has all the classical signs of tabes; Argyl-Robertson pupils, absent knee-jerk, muscular inco-ordination, trophic ulcers, etc. His blood and spinal fluid gave a positive Wassermann. He had pain in right side of trunk and involving leg. The pain has been so severe that the patient has attempted suicide four different times. He has become addicted to use of morphine. The patient was seen in consultation with Dr. Romeiser who had advised a root resection but on account of the extensive root resection necessary it was decided to divide the anterolateral column.

Operation, August 24, 1920. Through a laminectomy of the fifth, sixth, and seventh laminæ the cord was exposed. Because the right side of the body alone was involved only a unilateral section of the anterior column was attempted. The operation was performed as outlined above.

Postoperative notes. A painful, hyperæsthetic area appeared below the costal margin, probably due to the irritation of the cord at the corresponding segment, which required morphine for several days. There was some bladder tenesmus, retention, and incontinuence of urine at times. Diarrhœa persisted for 3 weeks. Pain disappeared from the right leg immediately following the operation. He occasionally complained of pain on left side of body. I believe a bilateral section should have been done.

CASE 2. Referred by Dr. Romeiser. P. B., a poorly nourished white male, age 32, received an injury to his spine in a railroad accident 8 years ago. Immediately following his injury a laminectomy was done at the level of the ninth, tenth, and eleventh thoracic vertebræ and a spicula of bone removed from the cord. Two years later Dr. Chaddock advised a section of the posterior roots which was attempted, but owing to the trauma, incident to the previous operation or injury, the nerve roots could not be identified and nothing was done. There is present incomplete paralysis of both legs with atrophy of muscles. The patient complained of severe pain in abdomen and lancinating pains in both legs. He requires morphine constantly. On advice of Dr. Romeiser a laminectomy was carried out September 8, 1920, by removing fifth, sixth, and seventh laminæ and a bilateral section of the anterolateral columns was made at level of sixth thoracic segment.

Postoperative notes. Pains in both legs have disappeared. For 2 weeks there was uncontrollable vomiting and during the second week some diarrhœa lasting 2 weeks. Tenesmus was present in bowels and bladder. A hyperæsthetic zone can be demonstrated at the tenth and eleventh segments. Pain and temperature sensation are absolutely abolished in both legs below the level of twelfth thoracic segment. There has been decided improvement in this patient. No opiate is required and he is much benefited by the operation.

CASE 3. Referred by Dr. Unterberg. Mrs. W. has been a sufferer from tabes for 20 years with more or less pain during this time. For the past 2 years she has not been free from pain a single day. She has been under the care of several neurologists. She has all the classical symptoms and signs of tabes with gastric crises and lancinating pains in both legs. On September 11, 1920, the fifth and sixth thoracic laminæ were removed by the usual laminectomy and the cord exposed. The presence of an old leptomeningitis was revealed which rendered the exposure of the lateral columns difficult. With careful search a point was selected and division of the anterolateral column made.

Postoperative notes. On arousing from the anæsthesia she said her legs felt like a new-born baby's. She was entirely unconscious of them except for her ability to move them. Loss of pain sensation was complete in both legs. The same hyperæsthetic area below the costal margin appeared, which required an opiate to relieve it. Bladder and bowel distention were marked and tenesmus of the bladder was very annoying. She was up and about in 2 weeks and did her own housework. She recently had a painful spot appear below the right scapula. The result from this operation was most satisfactory for relief of pain in body and legs. On account of the plastic meningitis found it would have been better if section of the posterior roots in the field of operation had been made.

CASE 4. Referred by Dr. Unterberg of the Alexian Brothers Hospital, and operated upon through the courtesy of Dr. Carrol Smith. M.D., age 46, a paper-hanger has been a sufferer from tabetic crises for past 10 or 12 years. He is blind in left eye, he had staggering gait during past 6 months. He had shooting pains in both legs for years. On October 22, 1920, a section of the anterolateral

columns was done, through a laminectomy at level of fifth, sixth, and seventh laminæ, preceded by a one-half per cent stovaine block.

Postoperative notes. There was very little disturbance following the operation. The patient was free from pain for several days and did not require any opiate. Says that he has occasional pain in feet. The neurological report has not been returned. Patient left hospital November 18, 1920. The patient's condition seemed much improved. All of the spinothalamic fibers apparently were not divided in this case.

CONCLUSIONS

From my experience in four cases I believe it has been shown that the operation will produce a permanent relief in any lesion below the thoracic level. In the cases of gastric crises I believe that the section will have to be made higher than the sixth thoracic segment, and see no reason why it should not be made as high as the second or third thoracic. I would also add to the operation section of the posterior nerve roots which are present in the field, as this would destroy sensory impulses which reach to a higher level and are not touched in the section of the anterolateral columns since this section includes only pain impulses which have crossed to the spinothalamic tract below this level. The researches of Head and Pilz would seem to show that pain and temperature fibers require four to six segments for their complete crossing in the cord. If this is so, the section of the several nerve roots which present in the field would seem to enhance the value of the operation especially in the tabetic case with pain involving the trunk. The removal of four laminæ instead of two and removal of four posterior roots would bridge the gap not included by the section of the anterolateral columns. I believe that a bilateral operation should be done in all tabetics; in inoperable tumor of the cord or such cases as reported by Beer of metastatic pelvic tumors.

The advice of Spiller that the incision of the cord might be carried forward even including the anterior horn or motor root in the thoracic region would appear to be a good one as little harm could be produced by it. The greatest danger is in cutting too far posteriorly and thereby injuring the pyramidal tract.

The operation while a delicate one is not difficult to perform, if one will familiarize himself with the subject. It should not be employed recklessly but only after due consideration and in consultation with the neurologist.

BONE ATROPHY

An Experimental and Clinical Study of the Changes in Bone which Result from Non-Use

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INTRODUCTION

THE fact that changes take place in the bones of the extremities when they are not used is generally known. The exact nature of these changes has not been clearly defined.

It has long been appreciated that the bones in an extremity which has not been used, due to paralysis, inflammatory disease, or injury, become lighter, more permeable to the roentgen-ray, and more fragile (1). These changes have often been attributed to the direct effects of trophic influences or inflammatory processes(2). When associated with injury alone, the assumption that non-use plays the important rôle in the causation of these changes has been made, but in these cases the emphasis has been laid on the changed arthitecture of the affected bones rather than on the changes in the bones as a tissue. The apparent complexity of bone as a tissue is simplified if it is regarded as a special type of connective tissue, composed of cells, and an intracellular matrix. The density, permeability, and strength of bones are properties of the matrix alone. Growth and regeneration are obviously properties of the cells alone. It, therefore, follows that changes in the matrix of bone need not necessarily influence its power of growth or regeneration. It is recognized that non-use during the period of growth results in diminution of the normal increase in length and thickness of the bones; but that complete lack of use does not result in complete cessation of growth of bone. It has not been clear, however, what difference there is between a bone that has not been used during the period of growth and one that has been affected by non-use after growth has been established.

Bone regeneration is a process which must be considered independently of the process of bone growth. The later process is confined to a definite period of life, and is associated with the processes of the entire organism. The former process may function at any period of life and is an intrinsic property of the bone as a tissue. It has not been known what relationship there is between bone atrophy and bone regeneration.

The apparent complexity of bone as a substance is simplified if it is regarded as composed of water, organic material, and mineral salts. The weight in part and the permeability to X-ray wholly depend upon the mass of mineral constituents in the bone. It is clear that a bone may become lighter, more fragile, and more permeable to X-ray as a result of diminished bone mass, or on account of a change in its chemical composition. The mass of mineral salts in a bone may be diminished either by a lessening of the volume of bone substance, or by a lessening of the proportions of mineral salts in the bone with no change in volume.

It has not been determined before which of these two conditions is responsible for the diminished weight and strength and the increased permeability to X-ray of bones which have not been used.

The purpose of this experimental and clinical study is to determine the effect of non-use of bones as it concerns:

1. X-ray photographs;
2. Gross and microscopic anatomy;
3. Chemical composition;
4. Breaking strength;
5. Growth; and
6. Regeneration.

EXPERIMENTAL METHOD

Dogs were used for the experiments. Three methods were employed to prevent use of the foreleg.

a. Section of the brachial plexus, resulting in partial or complete paralysis—13 experiments.

b. Excision of upper end of humerus, resulting in a flail joint—7 experiments.

c. Plaster-of-Paris fixation—4 experiments.

In each group of experiments the results of non-use for varying periods of time were studied. When the experiments were terminated the bones of both forelegs were compared by X-ray examination, measurements, weights, and as to chemical composition and breaking strength.

For the study of the effect of non-use on regeneration, the following method was employed. The animals in which one foreleg had been subjected to varying periods of non-use by the methods used, were operated upon again. This operation consisted of removal of a section of each ulna. The defect in the atrophied ulna was bridged by a transplant of bone with periosteum and marrow from the non-atrophied ulna. The defect in the non-atrophied ulna was bridged by a similar transplant from the atrophied ulna. This operative procedure gave in each animal two transplants in similar defects in each ulna. One transplant was atrophied bone placed in an extremity which was used. The other transplant was non-atrophied bone placed in an extremity which was not used. The results of these experiments were studied by means of the X-ray and macroscopic examinations.

In one experiment, No. 12, the transplants were not transposed. In this instance the defect in the ulna of the non-used extremity was bridged by an implant of atrophied bone, and the defect in the ulnæ of the used extremity was bridged by an implant of normal bone. In another experiment, No. 17, simple fractures were produced in the ulna of the used and non-used extremities.

These experiments showed changes in the bones which were the same in each of the methods used for producing non-use.

1. *Changes in X-ray photographs due to non-use.* A study of the X-ray photographs of the bones of the non-used forelegs reveals changes which are the same as are observed in the bones of a human extremity which has not been used. The earliest change observed as is shown in the experiments of shortest duration (7 to 30 days) took place in the cancellous extremities of the bones. The shadows of the trabeculæ became less defined, producing an effect suggesting imperfect radiographic technique (Fig. 2). In addition to the general lack of definition of the bone trabeculæ there are irregular areas in which the trabeculæ have disappeared entirely (Fig. 3).

In experiments of longer duration (30 to 100 days) a well marked change made its appearance in the compact bone of the shaft. This change was a decrease in the diameter of the shaft of the bone, an increase in the diameter of the medullary canal, the result of which was a cortex of diminished thickness (Fig. 4).

In the experiments of longest duration (100 to 314 days), the trabeculæ are well defined but very small and relatively very few in number. The compact bone of the shaft is further diminished in thickness and shows longitudinal striæ of diminished density (Fig. 5).

2. *Changes in gross and microscopic anatomy due to non-use.* The initial changes in gross anatomy of the bone due to non-use of an extremity are the same regardless of the age of the individuals. The ultimate result of the changes in gross anatomy of the bones of an extremity which is not used is different in the individual who has reached his complete growth, from that in the individual who is in his growing period at the time of onset of non-use. In the former instance, the process of bone atrophy is operating alone. In the latter, the process of bone atrophy is associated with the process of growth which is inhibited but not arrested by non-use. In this study both growing and adult dogs were used in experiments of relatively short duration (10 to 200 days). In the experiments of long duration (200 to 314 days) only adult dogs were used. However, the ultimate changes in the gross anatomy of the bones due to experimental non-use of an extremity beginning before the completion of growth are shown in the illustrations and measurements of Howell (3), and the effects of poliomyelitis, tuberculosis of bone, and congenital or acquired deformities in childhood give abundant opportunity for the study of these changes. The first change noted on the

TABLE I.—RESULT IN EXPERIMENT 26

	Weight Fresh	Weight Dry	Weight of Ash	Water per cent	Organic Matter per cent	Mineral Matter per cent
Used humerus	12.3 g.	6.0 g.	2.85 g.	51.2	25.7	23.1
Non-used humerus	11.7 g.	5.1 g.	2.02 g.	56.4	26.4	17.2
Difference	0.6 g.	0.9 g.	0.83 g.	+5.2	+0.7	−5.9

TABLE II.—RESULT AFTER 195 DAYS IN EXPERIMENT 5

	Water per cent	Organic per cent	Inorganic per cent
Compact bone of used ulna	15.6	32.7	51.4
Compact bone of non-used ulna	16.2	31.4	52.3
Difference	0.6	1.3	0.9

examination of a bone of an extremity which has not been used is in the relationship between the periosteum and the compact bone of the shaft. In normal bone, the periosteum strips from the bone with ease leaving a smooth, glistening surface. In atrophied bone, the periosteum strips from the bone with difficulty and leaves a surface which has the feel of fine sand-paper. The cancellous extremities of the bone are much more fragile and on section show fewer and smaller trabeculæ and a marrow containing increased amount of fat. Section of the shaft shows a cortex of diminished thickness with an enlarged medullary canal.

After relatively short periods of non-use (10 to 100 days) in individuals of all ages there are constant differences in the comparative measurements of the bones of the used and non-used extremities. The diameter of the shaft is diminished. The diameter of the medullary canal is increased. The increase in the diameter of the canal is greater than the decrease in the diameter of the bone (Fig. 1, Fig. 6). The cortex is diminished in thickness from both surfaces but proportionately more from the marrow surface. After relatively short periods of non-use also in adult dogs, there is no demonstrable difference in the length of the bones, comparing used with non-used extremities. In growing dogs, the bones of the non-used extremity, after short periods of non-use, may be slightly shorter than the bones of the used extremity but growth in length of bones is only retarded to a sufficient extent so that it is manifest after comparatively long periods of non-use.

TABLE III.—RESULT AFTER 256 DAYS IN EXPERIMENT 5

	Used Bone	Non-Used Bone
Weight fresh	18.11 grams	15.76 grams
Volume fresh	12.3 c.cm.	11.8 c.cm.
Specific gravity of entire bone	1.472	1.337
Weight of sample of compact bone of shaft	1.218 grams	0.550 gram
Weight of remainder of bone	16.66 grams	14.90 grams
Weight of mineral matter of sample of compact bone	0.727 gram	0.318 gram
Weight of mineral matter of remainder of bone	5.66 grams	3.71 grams
Weight of mineral matter in entire bone	6.387 grams	4.028 grams
Proportion of mineral matter in sample of compact bone	59.7 per cent	57.8 per cent
Proportion of mineral matter in entire bone	35.7 per cent	26.1 per cent

The ultimate effect of non-use for a long period on the bone of an adult is that the initial changes already described are much more marked. A further change becomes evident. This change is in the character of the cortical bone of the shaft which loses its compact structure and becomes porous (Fig. 7). This porosity of the bone explains the linear striæ of the shafts seen in roentgenograms (Fig. 8). It is to be emphasized, however, that none of these changes affect to any marked degree the general shape and contour of the bone as a whole. The diameter of the shaft is only slightly decreased and the length is not changed. In a bone, after a long period of non-use during growth, there is a very striking difference in shape as compared with the corresponding bone of the used extremity. The bone is smaller both in length and thickness; the decrease in thickness is more noticeable than that of length. Furthermore, the diminution in thickness is more marked in the shaft than in the epiphysis, producing an effect of sudden enlargement at the epiphyseal regions (Fig. 9). The periosteum strips from the bone normally. On cross section of the shaft the thickness of the cortex relative to the diameter of the bone shows a change

TABLE IV.—COMPARATIVE BREAKING STRENGTH OF METACARPAL BONES OF EACH FOOT, EXPERIMENT I

Bone	Used Bone	Non-Used Bone
Second metacarpal	21,200 grams	7,100 grams
Third metacarpal	24,000 grams	7,000 grams
Fourth metacarpal	21,300 grams	6,000 grams
Fifth metacarpal	18,000 grams	9,000 grams

TABLE V.—EXTREME FIBER STRESS

	Thickness (h)	Breadth (b)	Distance between supports (r)	Load (w)	Extreme Fiber Stress
Cortex of used humerus	2.35 mm.	3.41 mm.	25 mm.	6,000 gm.	12,000 per sq.mm.
Cortex of non used humerus	1.51 mm.	3.39 mm.	35 mm.	3,100 gm.	15,000 per sq.mm.

which is small as compared to that seen in bone atrophy occurring during adult life. Comparative measurements of the thicknesses of the entire bones and the diameters of the medullary canals show that the medullary canal of the non-used bone is always larger relative to the thickness of the same bone although it may be actually smaller than the medullary canal of the corresponding bone of the used extremity. There may also be a difference in the shape of the cross section of the bones, comparing used with non-used; for

TABLE VI.—EFFECT OF NON-USE ON REGENERATION OF BONE DUE TO NON-USE

No. of Exp.	Age of Animal	Method of Producing Non-use	Duration of Non-use before Transplantation	Duration after Transplantation	Method of Testing Regeneration	Degree of Bone Atrophy[1]	Regeneration Observed in Used Extremity[2]	Regeneration Observed in Non-used Extremity[2]	Remarks
18	Adult	Brachial plexus cut	32 days	101 days	Transposition of transplants	+	++++	++++	Fig. 18, Plate I.
1	Young	Brachial plexus cut	35 days	113 days	Transposition of transplants	+	+++	++++	Fig. 1, Plate I.
6	Young	Brachial plexus cut	39 days	80 days	Transposition of transplants	++	+++	+++	Fig. 6, Plate I.
7	Adult	Brachial plexus cut	39 days	137 days	Transposition of transplants	+++	++++	++++	Fig. 7, Plate I.
13	Adult	Brachial plexus cut	43 days	115 days	Transposition of transplants	+	+++	+++	Fig. 13, Plate I.
2	Old	Brachial plexus cut	188 days	116 days	Transposition of transplants	+++ Both extremities	+	++	Animal fractured radius in used extremity, both extremities showed impaired function.
4	Adult	Brachial plexus cut	195 days	119 days	Transposition of transplants	++	+++	+++	Fig. 4, Plate I.
5	Adult	Brachial plexus cut	195 days	61 days	Transposition of transplants	++++	+++	+++	Fig. 5, Plate II.
17	Adult	Excision of humeral head	79 days	57 days	Fractures of both ulnæ	+++	++++	++++	Callus about fractures in non-used extremity larger, but is more permeable to X-ray. Fig. 17, Plate II.
11	Adult	Excision of humeral head	47 days	91 days	Transposition of transplants	+++	++	++	Fig. 11, Plate II.
3	Adult	Excision of humeral head	37 days	77 days	Transposition of transplants	+++	O	+	Fig. 3, Plate II.
10	Adult	Brachial plexus cut and head of humerus excised	32 days	140 days	Transposition of transplants	+++	++++	++++	Fig. 10, Plate II.
12	Adult	Brachial plexus cut	47 days	117 days	Transplants not transposed	++	++++	++++	Fig. 12, Plate II.

[1]Explanation of + signs, Atrophy:
+, Slight atrophy.
++, Moderate atrophy.
+++, Marked atrophy.
++++, Extreme atrophy.

[2]Explanation of + signs, Regeneration:
++++, Complete regeneration of defect in bone.
+++, Transplant regeneration, united at one end.
++, Transplant regeneration, neither end united.
+, Slight regeneration.
O, No regeneration, transplant being absorbed.

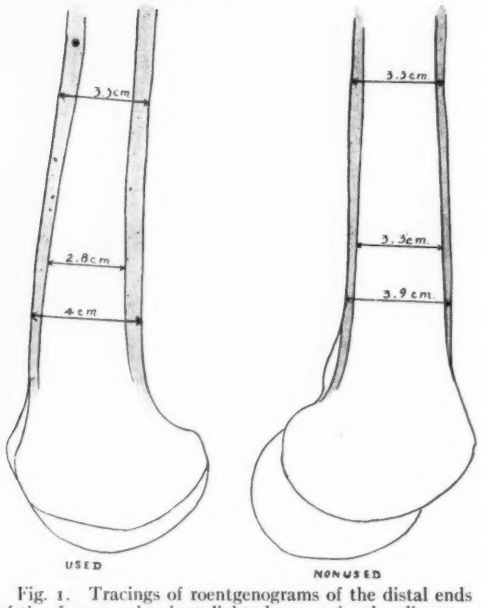

Fig. 1. Tracings of roentgenograms of the distal ends of the femora, showing slight decrease in the diameter of the bone and marked increase in the diameter of the medullary canal as a result of non-use following amputation.

example, the cross section of a normal used tibia is triangular in outline while the cross section of a tibia which has not been used during the growing period more nearly approaches a circle. (Compare Figures 7, 10, and 11.)

Microscopical sections of the epiphyses and shafts of used and non-used bones of each experiment were compared. Examination of these sections shows the same alterations as are evident on macroscopic study.

In both normal and atrophied bones there are evidences of bone absorption and bone regeneration.

The sections of atrophied bone show all stages of the process of atrophy as indicated by the diminishing number and size of trabeculæ, the decreasing thickness of the compact bone, and the accumulation of fat in the marrow, and ultimately the increased porosity of the compact bone (Fig. 12).

In none of the sections studied was it possible to observe the exact nature of this process.

3. *The changes in chemical composition of bone due to non-use.* The changes in the relative proportions of water, organic and inorganic matter in bone as a result of non-use is illustrated by the following described experiments.

Experiment 26. The brachial plexus of a young dog was divided. After 24 days of complete paralysis the animal was sacrificed and the humeri of both used and non-used extremities were removed. The bones were weighed in fresh state, after drying at 100° C. and after incineration. The results are shown in Table I.

Experiment 5. The left brachial plexus of an adult dog was divided. After 195 days a piece of the cortex of each ulna was removed, cleaned of soft parts and weighed fresh, dry and after incineration. The proportion of water, organic and inorganic matter is shown in Table II.

At the end of 256 days the animal was sacrificed and the humeri of both used and non-used extremities were removed.

X-ray examination showed marked atrophy of the non-used bone.

The weight and volume of each bone was determined. From the shaft of each humerus a portion of the compact bone was removed, cleaned of soft parts, and weighed fresh and after incineration. The remainder of each bone was weighed fresh and incinerated. The results are shown in Table III.

The results of these experiments show that non-use has no effect upon the chemical composition of the bone matrix. The proportions of water, organic and inorganic material in the bone as a whole are changed to marked degree by non-use for even comparatively short periods of time. It is evident from Experiment 26 that an entire bone may lose more than one-quarter of its mineral constituents during 24 days of non-use. In Experiment 5, when the non-use had existed for 195 days and there had been a marked diminution in the thickness of the cortex of the shaft, it was found that there was no appreciable difference in the chemical composition of this cortical bone when compared with the cortical bone of the used extremity.

It, therefore, follows that the loss of mineral constituents due to non-use of a bone is a loss of bone matrix rather than a loss of mineral constituents of bone matrix.

In other words there is, as a result of non-use, less bone matrix present rather than any change in the character of the bone matrix

Fig. 2. Roentgenogram of humeri of used (below) and non-used (above) extremities 24 days after section of the brachial plexus, showing less definition of the bone trabeculæ of the non-used humerus. Experiment No. 26.

The change is quantitative rather than qualitative.

It is obviously impossible to determine the chemical composition of the matrix of spongy or cancellous bone independent of the marrow tissue it contains. It is likewise impossible to determine accurately the composition of the matrix of the cortical bone of the shaft in case this bone becomes porous. Thus in Experiment 5 when the non-use had continued for 256 days there was found a small difference in the proportions of mineral constituents in the cortical bone of the used and non-used shafts. The difference was due to the fact that the cortical bone of the non-used extremity was more porous and, therefore, the sample analyzed contained more of marrow-like tissue.

4. *The effect of non-use on the strength of bones due to non-use.* The relative resistance of materials to external force is determined by various methods according to the effects on the material of the applied force; for example, compression strength, bending strength, torsion strength, breaking strength, etc., etc.

The simplest and most accurate method of estimating the relative strength of bones is to determine the minimum force which will break the bone when the bone is resting on two horizontal supports and the force is applied as an increasing weight at a point equidistant from the two supports.

Fig. 3. Roentgenograms of humeri and radii of used (above) and non-used (below) extremities 7 days after section of brachial plexus, showing in tuberosity of humerus and head of radius of non-used bones areas in which the trabeculæ have disappeared. Experiment No. 9.

For the determination of the comparative breaking strength of the bones in these experiments, a simple apparatus was used in which the horizontal supports were constantly 25 millimeters apart and the increasing weight applied at the point mid-way between the supports was obtained by hanging a container from this point and adding sand until the bone broke. The sand was then weighed. In each experiment the breaking strength of the bones of the used and non-used extremities was determined.

The results obtained are illustrated in the following experiment.

Experiment 1. Left brachial plexus cut in an adult dog, resulting in a complete paralysis of the foreleg. At the end of 113 days the animal was sacrificed and the bones were removed from the two extremities. X-ray examination of bone showed marked atrophy of bones on the left side (Fig. 13).

The comparative breaking strength of the metacarpal bones of each foot is shown in Table IV.

From this table it is evident that there is a marked difference in the breaking strength of the bones of the used and non-used extremi-

Fig. 4. Roentgenogram of the bones of used (above) and non-used (below) extremities 110 days after excision of the head of the humerus, showing diminished thickness of cortex of the shafts of the bones of the non-used extremity. Showing also the results of transplantation. See Table VI and Plate II, Experiment No. 3.

ties. The figures given are the breaking strength of the whole bones. It is obvious that the breaking strength of the shaft of a bone depends on the shape and area of the cross section. It has already been shown that in the bones of non-used extremities there is a decrease in the diameter of the shaft as a whole and an increase in the diameter of the medullary canal. The breaking strength of a bone may also be affected by a change in the character of the bone matrix. In order to determine if the decrease in breaking strength of the whole bone is due entirely to changes in shape and area of the cross section, or to

Fig. 5. Roentgenogram of the humeri of the used (below) and non-used (above) extremities 256 days after section of the brachial plexus, showing extreme atrophy of bone.

Fig. 6. Roentgenogram of the bones of an amputation stump showing extreme atrophy. The onset of non-use as after-growth was established. Compare Figure 9

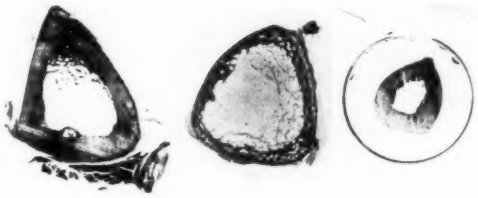

Fig. 11. Fig. 7. Fig. 10.

Fig. 7. Photograph of a cross section of the non-used tibia shown in Figure 8. Natural size.

Fig. 10. Photograph of a cross section of a tibia which was not used during the period of growth. The roentgenogram is shown in Figure 9. Natural size.

Fig. 11. Photograph of a cross section of the normal adult tibia, shown for comparison with Figures 7 and 10. Natural size.

intrinsic changes in the bone matrix, a rectangular piece of cortex from the shaft of the humerus, the cross section area of which could be accurately measured, was prepared from the used and non-used extremities. The breaking strength of these specimens was determined by the method already described. The breadth and thickness at the breaking point were measured with a micrometer caliper. The "extreme fiber stress" was obtained by substituting these values in the general formula applicable to rectangular beams on two supports with the load in the middle.

$$F = \frac{3\ W\ l}{2\ b\ h^2}$$

Table V shows the results obtained.

These results show that although the cortex of the non-used bone supported only about

Fig. 9. Roentgenogram of the bones of the leg of an adult which had not been used since early childhood as a result of tuberculosis of the femur. See Figure 10.

one-half the load supported by the cortex of the used bone, nevertheless if the load per unit of the cross section is considered, the extreme fiber strength of the two bones is equal within the limit of experimental error.

It follows, therefore, that the bones of a non-used extremity break more readily owing to a diminution in the thickness of the bone rather than to any change in the nature of the bone substance.

6. *The effect of non-use on regeneration of bone due to non-use.* The most accurate method of determining the power of regeneration of a bone is by observing the regeneration of a transplant removed from this bone and placed in a bone defect.

By the experimental methods described three types of transplants were obtained. First, bone transplants were removed from bone which had become atrophied owing to non-use of an extremity and placed in defects in normal bone in an extremity which was used. Second, transplants were removed from normal bone and placed in extremities

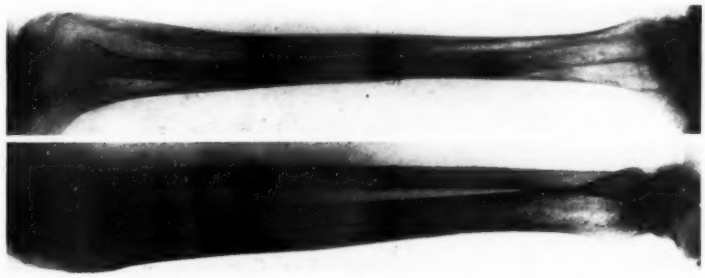

Fig. 8. Roentgenograms of the bones of the legs of a woman aged 42 years who had not used one leg in walking for over 6 years as a result of a traumatic deformity of the foot. Note the diminished thickness of the cortex of the shafts of the bones of the non-used leg (above) and the longitudinal striæ of diminished density. A cross section of this bone is shown in Figure 7.

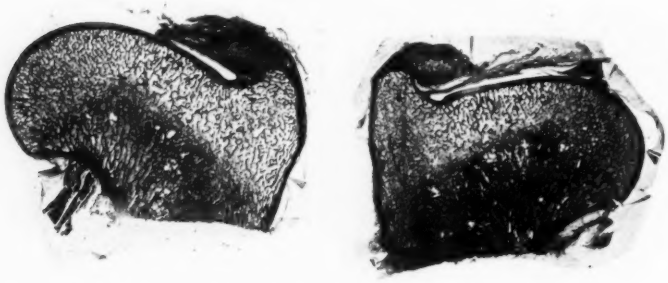

Fig. 12. Photomicrographs of the heads of the used and non-used humeri of a dog 314 days after section of one brachial plexus.

which were not used. Third, transplants were removed from bones which had become atrophied and were placed in extremities which were not used. The period of non-use of the extremity from which the transplant was taken varied from 32 to 195 days. The length of time between the transplantation and the termination of the experiment varied from 61 to 119 days. (See Table VI).

Fig. 13. Roentgenograms of bones of used (at left) and non-used forefeet of a dog 113 days after section of one brachial plexus. The comparative breaking strengths of these metacarpal bones is shown in Table IV.

In experiments Nos. 18, 1, 6, 7, 13, 2, 4, and 5, in which non-use resulted from section of nerves producing paralysis for periods varying from 119 days to 314 days, in which the amount of atrophy varied from slight to extreme degree, and in which regeneration of normal bone in a used extremity, atrophied bone in a used extremity, normal bone in a non-used extremity, and atrophied in a non-used extremity was studied, no difference was observed.

In experiments Nos. 11, 3, 10, and 12 in which non-use was produced by excision of the head of the humerus and in which the same transplantations were studied, there was no difference in the regeneration observed.

In experiment No. 17, in which the healing of simple fractures in used and non-used bones were studied, no difference in regeneration was found.

From the results of these experiments, it is clear that non-use of an extremity has no effect upon the regeneration of its bones. Regeneration is here defined as the ability of a bone to repair a defect caused by injury (Plates I and II).

DISCUSSION

In these experiments in which non-use was produced by nerve paralysis, injury to joints and simple fixation, the changes observed in the bone were the same.

The degree of atrophy of the bone was directly proportional to the degree of non-use regardless of the method used to produce the non-use. Simple fixation produced as rapidly developing and as marked bone atrophy as

Plate I. Photographs showing the results of the transplantation of bone in used and non-used extremities in Experiments 18, 1, 6, 7, 13, and 4. See Table V.

non-use due to section of nerves or injury to joints. Complete fixation of a dog's extremity is so difficult that this method was not extensively employed. There is no evidence warranting the assumption that any disease process plays any rôle in the production of bone atrophy other than its effect on use. That bone atrophy is not the result of diminished circulation of blood is shown by the fact that bone atrophy rapidly develops in the acute inflammatory diseases which limit the function of an extremity. Also we have observed a patient who had ligation of the popliteal artery and a diminution of blood supply to the leg sufficient to cause a complete ischæmic paralysis and a slowly developing gangrene yet the tibia showed no evident atrophy after a period of 4 months.

Bone absorption is an active process and the circulation of the blood is necessary to its progress. The process of bone atrophy is not a change in the characteristics of bone as a tissue. The process of bone atrophy is not a change in the characteristics of bone as a substance. The process of bone atrophy is a change in the amount of bone present. This

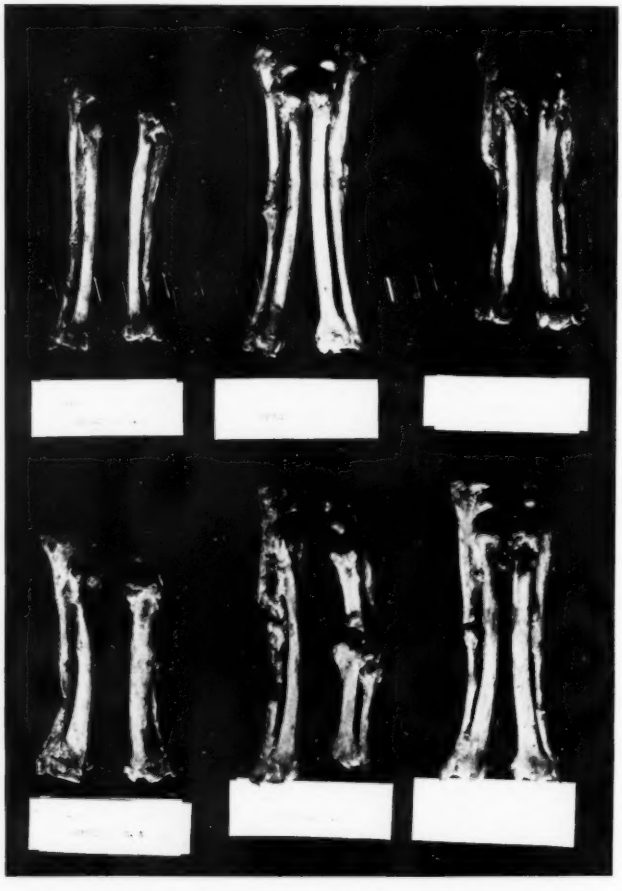

Plate II. Photographs showing bone regeneration in used and non-used extremities in Experiments 5, 17, 11, 3, 10, and 12. See Table VI.

affects the size, shape, thickness, length, weight, and texture of the whole bone and accounts for its changes in gross anatomy, X-ray photographs, breaking strength, and chemical composition. The chemical composition, breaking strength, and regeneration of *bone* remain unchanged.

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THE DELAYED TRANSFER OF LONG PEDICLE FLAPS IN PLASTIC SURGERY[1]

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THE loss of a large cutaneous flap intended for the correction of a defect is always at least an embarrassment to the surgeon and often little short of a tragedy to the patient.

The following illustrated record of disaster and near-disaster is given to emphasize one essential risk in this work and to demonstrate a means adopted to lessen the likelihood of such occurrences.

A somewhat extensive observation in the making and transplanting of cutaneous flaps for the correction of superficial defects has led to the following conclusions:

1. That about the neck and face of a man in ordinary health, regardless of age, rather long flaps can be made with little danger to their vitality provided the return circulation is obstructed neither by gravity nor kinking or torsion of the pedicle (Fig. 2), but that in women and children the circulation is not so vigorous and equally long flaps are less likely to survive (Figs. 1, 3, 4, 5, and 10).

2. That in any instance, the chance of success is increased, or a longer flap can be raised, or the flap can be cut narrower and thinner, with equal chance of success if it is first completely raised and then immediately sutured back into its original bed and the transfer to the new position delayed for a period varying from 6 days to 2 weeks.

3. That if a flap does slough in its original bed, the extent of the area lost will be considerably less than if it had been immediately transplanted (Fig. 3).

4. That sloughing of an untransplanted flap is apt to be superficial without destruction of the full thickness of the skin, while a slough occurring after transfer is more apt to involve the full thickness of the flap (Fig. 4, *a* and *b*).

5. That if a flap will not survive, it is a real advantage to have this fact demonstrated before removal of the scar and freshening of the edges of the defect (Figs. 3, 4, and 5).

6. That provision for a possible partial loss can usually be made in the original planning of the flap (Figs. 4, 8, and 9).

7. That in the transplanted position, gravity may be more favorable to venous and lymphatic drainage, but this will not always compensate for other deleterious factors essential to immediate transfer (Fig. 2).

8. That if it becomes evident that the transplanted flap is in danger of sloughing, it

a *b*

Fig. 1. Partial slough of a short broad flap in an infant. *a*, The condition at 24 hours, the time of operation. Only the mesial half of the very wide right ala bordering on this oblique facial cleft was used in reconstructing the nostril and though the soft tissues of the right half of the external nose were raised from the nasal bone, they were disturbed in no other way but, in spite of this, it will be seen in *b* (at right), taken 7 days later, that almost all of the right ala has sloughed away.

[1]Presented before the Southern Surgical Association ,Hot Springs, Virginia ,December, 1920.

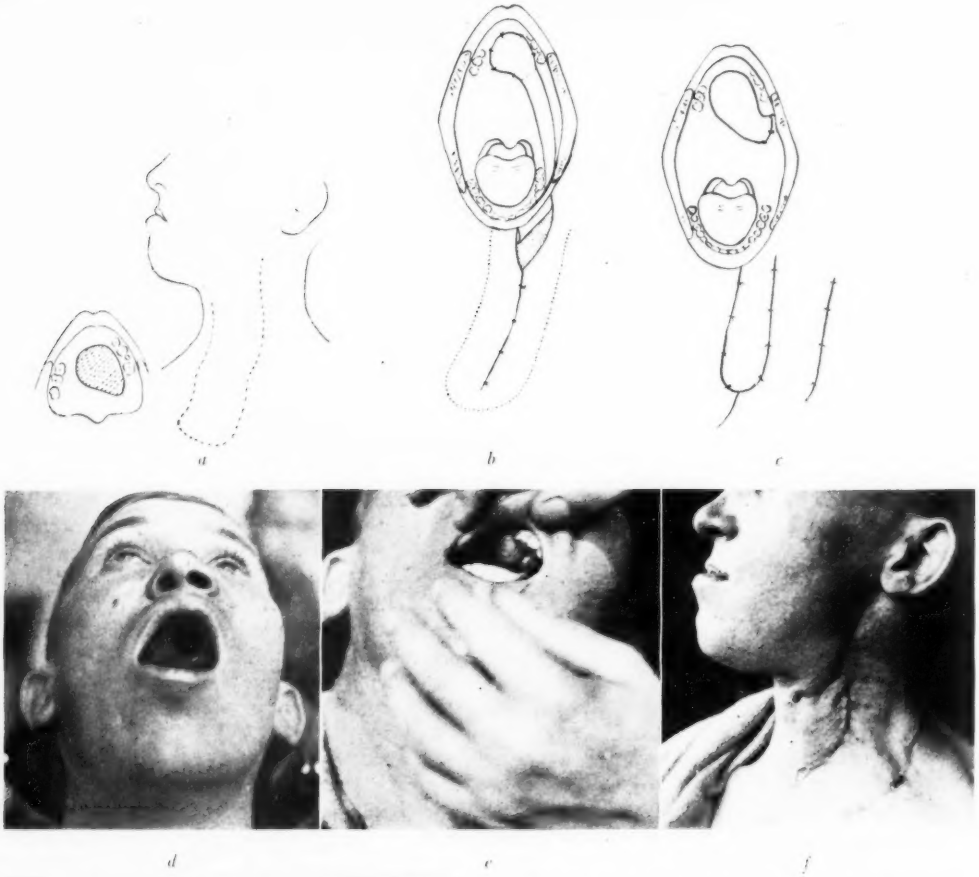


Fig. 2. Restoration of a palate by immediate transplantation of a neck flap. *a*, Shows the defect and the neck flap outlined; *b*, shows the neck flap sutured into the palate through an opening in the buccal fornix; *c*, shows the restored palate with the pedicle of the flap returned to the neck; *d*, *e*, and *f*, are photographs showing actual conditions.

Immediate transfer of a flap of this type to a position higher than its base will usually succeed in the adult male but in a child it will probably fail.

Fig. 3. A sloughing flap. This figure shows a flap that was raised and sutured back into the neck with the intention of later transplanting it into a palate defect. No further attempt was made to transplant the flap but the child was saved a great deal by not having the flap placed in the mouth. A previous attempt had been made on the other side immediately to transfer a neck flap to the palate and the whole flap sloughed.

is better immediately to place it back in its original bed. By so doing not only will time be saved but, not improbably, a much larger part of the flap (Figs. 5 to 14, c and d).

9. That when a flap is to be split into two or more narrow flaps, such as to cover the eyelids or lips, or to line the nose, it is safer to delay splitting the flap until the time of

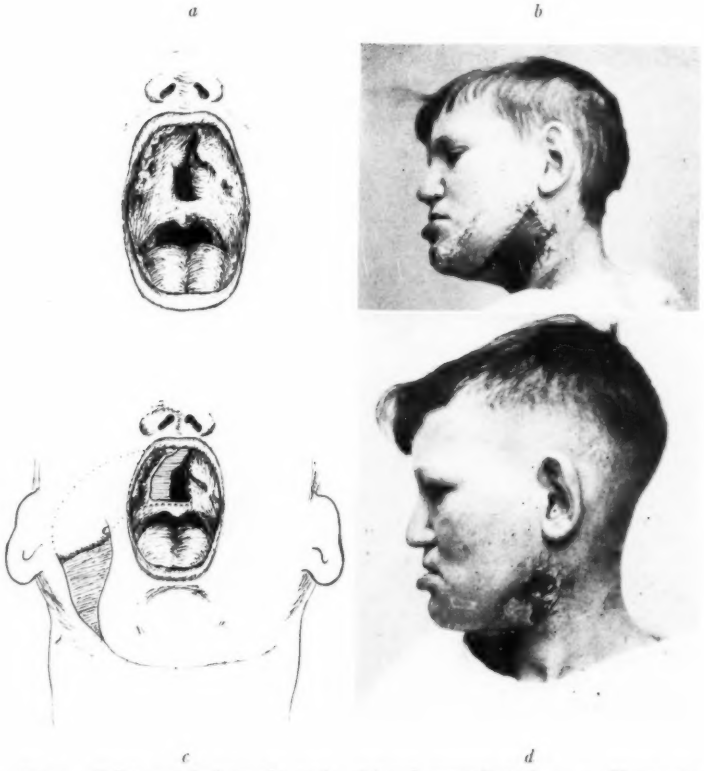


Fig. 4. Palate repair from the neck; delayed transplantation. *a*, Shows the palate in a 10-year-old child, a mass of scar resulting from the development of scarlatina the day after operation for the repair of the palate at the age of 1 year; *b*, shows the slough that occurred after raising a neck flap and suturing it in its original bed preparatory to transplanting it into the palate defect. *d*, taken 30 days later, shows that the skin was completely destroyed in only a part of the sloughed area shown in *b*. It was originally intended to have the base of this flap located near the mid-line under the skin but, after the occurrence of the slough, an incision was made dividing the healthy from the damaged tissue, the latter was left in place and the incisions outlining the flap were extended across under the chin so as to bring the base on to the right cheek. An opening was made through the mucosa and buccinator muscle in the right bucco-alveolar fornix and, after freshening the edges of the palate defect, the tip of the flap was sutured in place. In *c*, the dotted line represents the position of the flap sutured into the palate. After union had occurred, the pedicle was cut and returned to the neck.

transplantation or to an intermediate time rather than to do it at the time the flap is first raised (Figs. 6 and 7).

10. That in a neck flap which includes a section of the clavicle for a pedicle bone graft, the soft tissues will have a firmer attachment to the bone and, I believe, the bone will be more resistant to infection if the transfer is delayed.

11. That a blood clot under a flap that has been sutured back into place may be fatal to the flap. This is avoided by moderate pressure of dressings and use of multiple drains, to be removed in 24 hours (Fig. 12, a).

12. That if there is to be a raw surface left exposed on the pedicle after transplantation of the flap, it will be more

(CONTINUED ON PAGE 272)

Fig. 5. Attempted palate repair from neck flap; failure in spite of delayed transplantation. A girl of 16 had had several previous unsuccessful attempts to repair the palate. The outlined flap which included the hair-free skin just behind the ear was liberated but left attached at both ends and sutured back in its bed. A slight superficial slough occurred near each border about the middle of the flap. The general discoloration is due to the iodine used at operation. During the period of 10 days following the raising of the flap, the base of the upper pedicle was intermittently compressed each day by a spring until it was believed that the whole blood supply came through the lower pedicle. Then the upper pedicle was cut and the flap again elevated and again sutured back in its bed. Two days later the upper end of the flap was sutured into the palate defect, the resulting neck defect being filled in with a Wolfe graft. The tip of the flap was turned black and, the flap was detached from the palate, the slough removed and the pedicle replaced in the neck, as the operation had failed.

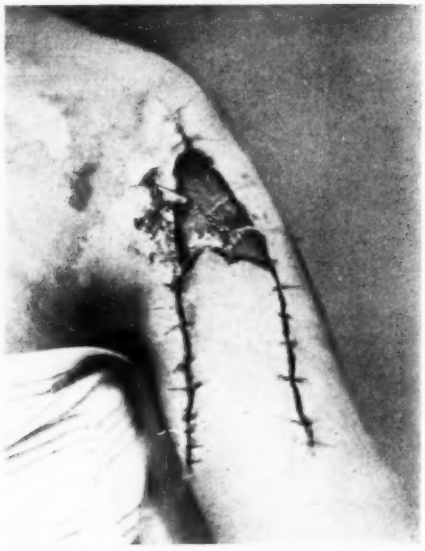


Fig. 6. Sloughing flap on the arm of a child. The flap shown here was made on the arm of a 12-year-old boy with the intention of transferring it to the upper lip and the side of the nose on a burned face. The flap was split at the time it was raised and this part sloughed. It was not used.

I believe the lessons to be drawn from case in Figure 5 are that the base of the upper pedicle was made too narrow, that when any part of a flap shows the least inclination to slough this part should not be transplanted, and that 2 days is not long enough to determine the viability of a flap.

a

b

c

Fig. 7. Delayed transplantation of a forehead flap for eyelid repair. *a*, Shows a child with facial burns of peculiar distribution; *b*, shows an outlined forehead flap that was cut very thin and sloughed in its distal part; *c*, shows the later implantation of the flap after splitting it so as to apply to both lids.

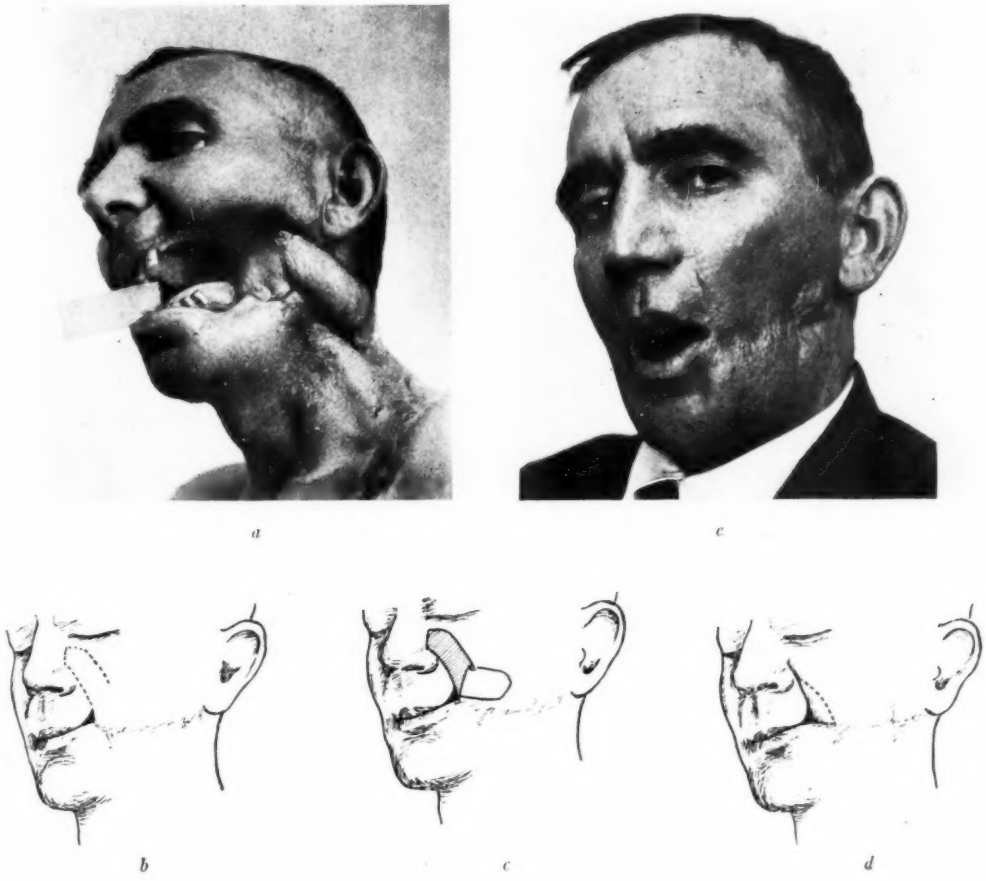
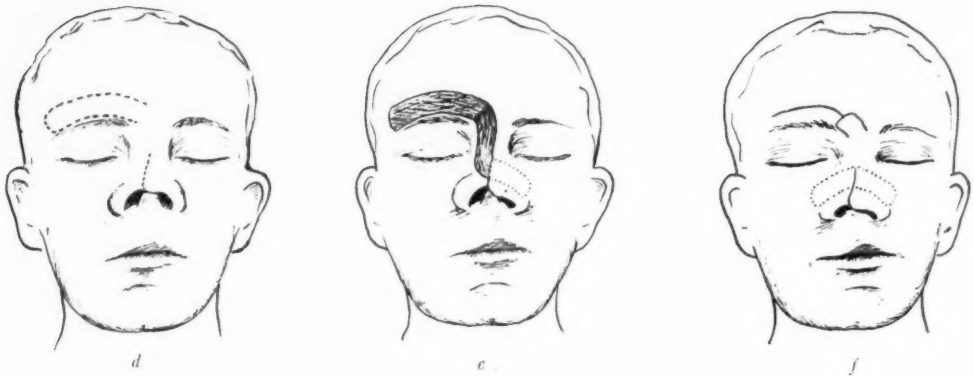


Fig. 8. Repair of pharynx and cheek with a neck flap. Immediate transplantation failed, later transplantation was successful. Following the excision of the mucosa of the cheek, the buccinator muscle, the left tonsil, half of the vellum and part of the pharynx with a cautery for the removal of a widespread, recurrent, carcinomatous verruca, the jaws could not be separated and there was a wide defect in the cheek as shown in *a*. A flap was cut 3 inches wide and 3 inches below the left ear and the tip was taken from in front of the shoulder. The tip was immediately implanted into the defect that remained after the scar was cut from the velum, pharynx, and from between the jaws. Part of the tip of the flap sloughed and part remained attached within the mouth but not enough to permit the jaws to separate, scar having again bound them together. At a subsequent operation, the tip was cut from its attachment within the mouth, the flap lengthened by extending the pedicle upward so that the base was nearer the ear and, after removing the intra-oral and pharyngeal scars, the tip was successfully reimplanted as shown in *a*. At a later period after a new blood supply was established, the pedicle was cut at the base and unrolled, the skin edges were freed from the jaws and the cheek lined by turning the pedicle forward. The anterior end of the pedicle sloughed so that the jaws again became bound together, this time by a scar near the corner of the mouth. To correct this, a flap was taken from beside the nose, *b*, and transferred into the mouth to supplement the cheek lining, shown in *c*. Later the base of the cheek flap was cut across at the dotted line, in *d*, and the pedicle was used to line the left half of the upper lip. *e*, Shows the final cosmetic results and the ability of the patient to open his mouth. The excision of the growth was done 2 years before and there is no sign of a return of the disease.

The successful outcome of the repair in this case was primarily dependent upon the fact that the base of the original flap was so placed that we were able to lengthen it after the tip sloughed. If the transfer of the original flap had been delayed, this would not have been necessary.

a *b* *c*



d *e* *f*

g

Fig. 9. Nose with cartilages, lining, and columella destroyed by syphilis. The columella was replaced by a flap from the upper lip but this left no breathing space. The floor of each nostril was widened by turning in the flaps outlined in *b* giving the result shown in *c*. To restore the lining of the nose, the forehead flap shown outlined in *d* was cut very thin and sutured back into its bed. A week later the nose was split along the dotted line in *d* and, after cutting out the scar that bound the border of the nostril to the left nasal bone, this half of the nose was lined with the tip of the forehead flap as shown in *e*. Later the pedicled of the forehead flap was cut near its base and used to line the right side of the nose as shown in *f*. *g*, Shows the result in this case.

In a case previously operated upon, immediate transplantation of the forehead flap was attempted, resulting in a partial slough of the tip and the operation had to be repeated by making an entirely new flap because no provision had been made for lengthening the flap as shown in the case illustrated in Figure 8.

Fig. 10. Superficial slough on tip of a flap intended for a lining of the nose. The sloughed part was left in its original place and, after the slough separated, so little of the thickness of the skin had been destroyed that it showed no damage. This was the second attempt to procure a flap to line this nose. The first time an immediate transfer was attempted, followed by a slough of the flap in the nose.

Fig. 11. Immediate transplantation of a flap followed by sloughing. A relatively short flap is shown raised from the neck and transplanted into the cheek to relax scars on the burned face of a 6-year-old child. After raising the flap its color was so good that an immediate transplantation was made in place of a delayed transfer as was first intended. Half of the flap sloughed.

a *b*

c

Fig. 12. Delayed transplantation of a long neck and chest flap to the face of a burned child. *a*, Shows the flap which has been raised but left attached at both ends, sutured back into its bed and tubed at its lower end for convenience of intermittent constriction; *d*, *d*, *d*, are rubber dam drains for immediate drainage of serum; *g*, is a gauze strip under the tubed pedicle by which it was constricted. The dotted line and shaded area on the face show the incisions into which the flap was later implanted after undermining the scar for relaxation. After a blood supply through the upper pedicle was assured, the lower pedicle was cut and the flap transferred to the face *b*. *c*, Is a photograph of the flap in place and also shows the rubber bands so placed as to take the tension off the tubed pedicle.

a *c* *b*

Fig. 13. Delayed transfer of a submental flap to the upper lip and nose. Stout women are particularly difficult subjects on which to obtain thin, narrow flaps. *a*, Shows a submental flap cut with a double pedicle, one tubed for intermittent compression; *b*, shows the flap transplanted to the upper lip and three flaps outlined on its pedicle; flap *1* was used to line the newly constructed nostril, flap *2* made the ala and covering for the side of the nose, while flap *3* replaced a scar in the lower lip as shown in *c*. Flaps *1* and *2* were raised and sutured back into their beds at a preliminary operation, but flap *3*, on account of the difficulty of previsualizing its exact position, was not raised until *1* and *2* were implanted in their new positions, when *3* was immediately transferred to its new site. Flaps *1* and *2* survived entirely without hesitation but half of flap *3* sloughed.

Fig. 14, *a*. Repair by multiple flaps with delayed transplantation. Photograph showing the condition immediately after the destruction of a large carcinoma of slight malignancy which had been indolent for 15 years but became active following the use of irritants and radiation. It was removed with the chisel and cautery.

Fig. 14, *i*. Shows the result to date ready for the finer work about the eye socket for the wearing of an artificial eye, a cartilaginous graft to restore the malar eminence, a Wolfe graft in the forehead, and restoration of the right angle of the mouth.

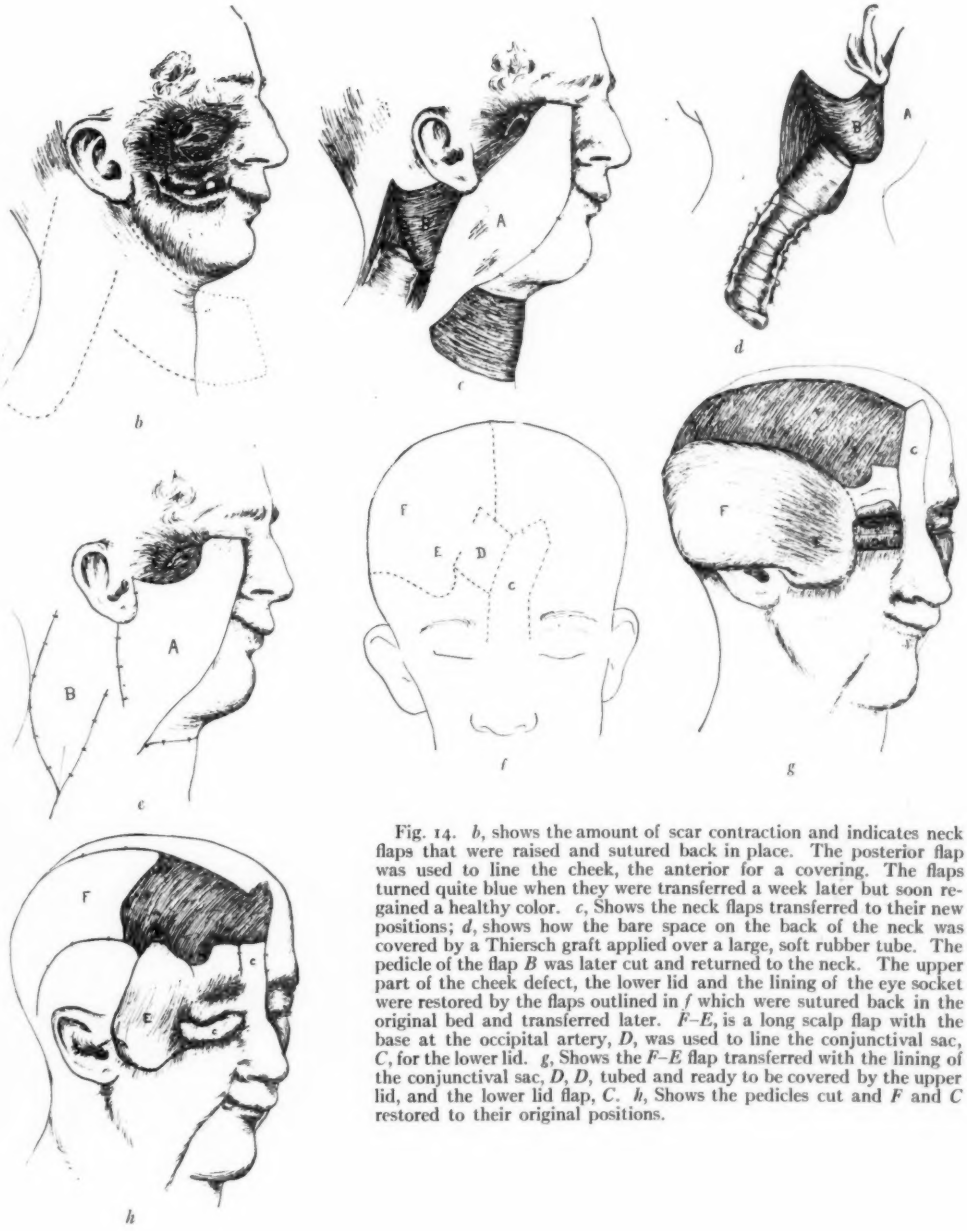


Fig. 14. *b*, shows the amount of scar contraction and indicates neck flaps that were raised and sutured back in place. The posterior flap was used to line the cheek, the anterior for a covering. The flaps turned quite blue when they were transferred a week later but soon regained a healthy color. *c*, Shows the neck flaps transferred to their new positions; *d*, shows how the bare space on the back of the neck was covered by a Thiersch graft applied over a large, soft rubber tube. The pedicle of the flap *B* was later cut and returned to the neck. The upper part of the cheek defect, the lower lid and the lining of the eye socket were restored by the flaps outlined in *f* which were sutured back in the original bed and transferred later. *F–E*, is a long scalp flap with the base at the occipital artery, *D*, was used to line the conjunctival sac, *C*, for the lower lid. *g*, Shows the *F–E* flap transferred with the lining of the conjunctival sac, *D*, *D*, tubed and ready to be covered by the upper lid, and the lower lid flap, *C*. *h*, Shows the pedicles cut and *F* and *C* restored to their original positions.

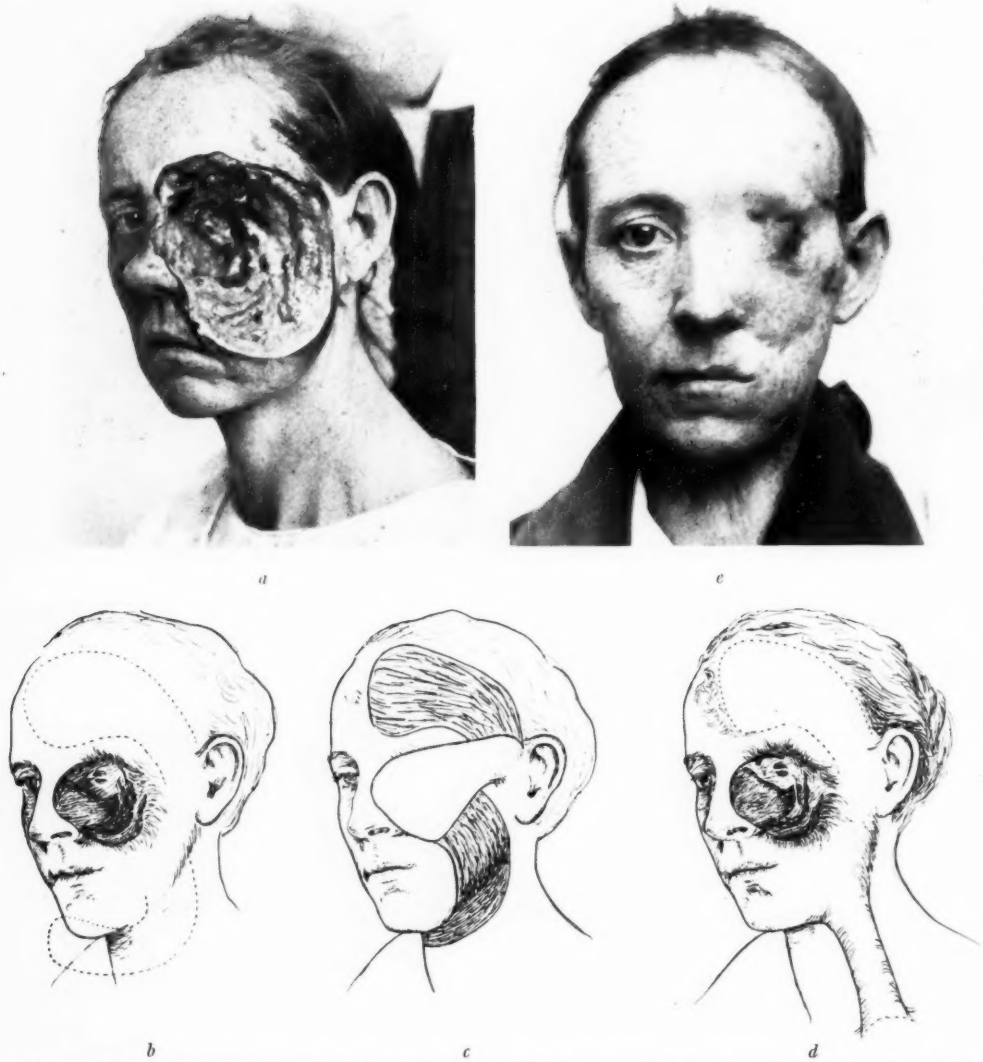


Fig. 15. Failure to close cheek-orbit defect by immediate transplantation of a forehead and submental flap. Success by a later delayed transplantation. *a*, Shows the condition after removing a carcinoma from the cheek and orbit with cautery and chisel. The nasal septum and ethmoid cells show in the bottom of the wound. This growth had remained small and indolent until irritated into activity by the use of a cancer paste. *b*, Shows the condition after scarring had occurred. The dotted lines illustrate two flaps that were raised to fill the defect, the upper as an outer covering, the lower as a lining. The upper flap has the temporal artery and vein in its pedicle and this is usually considered safe for immediate transfer. The lower flap being brought to a position above its base is less likely to be embarrassed by impeded blood return. Immediate transplantation was done, shown in *c*, but the next day the blueness of the forehead flap strongly suggested the advisability of removing all sutures and restoring it to its original position to save as much of it as possible. The neck flap was tubed and attached to a small flap turned from the chest, shown in *d*. About 2 centimeters of forehead flap was lost by slough. At a later period, repair was made with delayed transplantation of the remaining part of the forehead flap and the tubed neck flap. *e*, Shows the healed condition ready for making a socket to carry an artificial eye.

a *b* *c*

Fig. 16. Restoration of an eye socket and eyelids. *a*, shows a soldier in whom a piece of shell passed through the malar bone and outer wall of the orbit, through the orbit into the nose, destroying everything but the outer skin of the upper lid and leaving a large communication between the orbit and the nasal fossa. A posterior wall was given to the conjunctival sac and the communication between the orbit and the nose was closed by a flap taken from the forehead. The upper lid was made to do duty for both lids and a lining for the lids, as well as a flap for the repair of a nasal defect, was obtained from the forehead by delayed transplantation. *b*, Shows the flaps in place, the pedicles not yet cut; *c*, shows the glass eye in place but the nose not finished.

a *b* *c* *d*

Fig. 17. Reconstruction of an ear. *a*, Shows what remained of an ear after an automobile accident, also three flaps that were raised and sutured back into their beds to be later draped over a cartilaginous implant from the fifth costal cartilage. The long neck flap sloughed at its tip while in its original bed. *b*, Represents an intermediate stage; *c* and *d*, show the present condition and a year will elapse before final adjustments are made.

resistent to infection after a delayed transfer.

13. That certain complicated, time-consuming operations are advantageously divided into two sittings by this procedure.

14. That occasionally after suturing the flap back in its original bed, the transplantation will of necessity be long delayed by a low grade suture infection or an infection in the bed. Any of these occurrences is an incident rather than a calamity and is to be guarded against by not drawing the sutures tight, by removing them early, by free drainage and ordinary cleanliness.

15. That when any part of the flap sloughs while in its original bed, that part, no matter how superficial the slough, should not be transplanted (Fig. 5).

16. That another disadvantage of the method, more apparent than real, is it involves two operations in place of one. My own experience has been that two properly planned operations usually bring success while the single operation has too often been followed by immediate failure necessitating a larger number of subsequent steps.

17. That even delayed transfer has not been successful in every case (Fig. 5).

The accompanying pictures were selected to bring out the various points related to the phase of the subject under consideration.

FRACTURES OF TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRÆ[1]

By GEORGE G. DAVIS, M.D., F.A.C.S., Chicago

FRACTURES of the transverse processes of the lumbar vertebræ are not infrequent injuries but have been frequently overlooked. With modern improvement of our X-ray technique, aided by the use of duplitized films, intensifying screens, and especially the Potter-Bucky diaphragm, many cases formerly diagnosed "sprained back," "malingering," etc. are now found to be fractures of the transverse processes.

In reviewing the literature on this subject there seems to be considerable difference of opinion as to the factor in causing the fracture. Some observers (Hartwell, 1; Roberts and Kelly, 2; and others) state that the process fractures result almost invariably from direct trauma. DeQuervain (3), Traves (4), and others say that the injury may result from direct or indirect violence. Stimson (5) states that fractures of the transverse processes occur in combination with other fractures, but are rare except in such cases and that in the few instances in which fracture has occurred alone it is the result of gunshot injury. Rhys (6) states that these fractures are developmental in origin adding that fractures occur in the absence of injury in almost all the cases and that the first lumbar is the most frequently affected.

A review of the embryology of the transverse processes in the lumbar region and a study of the transverse processes, with relation to their muscular attachments, seem to clear up several points in etiology.

EMBRYOLOGY

The cartilaginous vertebra is ossified from three primary centers, two for the vertebral arch and one for the body (Fig. 1). The ossific granules appear first in the situations where the transverse processes afterward project, and spread backward to the spinous process, forward into the pedicles, and laterally into the transverse process. At birth the vertebra consists of three pieces: the body and the halves of the vertebral arch. Before puberty no further changes occur except a gradual increase of these primary centers, the ends of the transverse processes being cartilaginous. About the sixteenth year, two secondary centers appear, one for each transverse process. These secondary centers fuse with the transverse process about the age of 25 (Fig. 2). From this secondary

[1] Read before the Chicago Surgical Society, April 1, 1921. (For discussion see p. 314)

Fig. 1 (at left). Showing the three primary centers of ossification of the vertebra: two for the vertebral arch and one for the body. (Gray's *Anatomy.*)

Fig. 2. Showing secondary centers of ossification for transverse processes which appear at about the sixteenth year and which fuse with the primary centers normally at the twenty-fifth year. (Gray's *Anatomy.*)

center the transverse process of the first lumbar is sometimes developed as a separate piece, which may remain permanently ununited with the rest of the bone, thus forming a lumbar rib (Fig. 5, Case 2).

ANATOMY

The muscle in which we are most interested in considering transverse process fractures in the lumbar region is the quadratus lumborum (Fig. 3). It is irregularly quadrilateral in shape and broader below than above. It arises by aponeurotic fibers from the iliolumbar ligament and the adjacent portion of the iliac crest for about 5 centimeters, and is inserted into the lower border of the last rib for about half its length, and by small tendons into the apices of the transverse processes of the lumbar vertebræ.

The action of the quadratus lumborum muscle is to draw down the last rib and it acts as a muscle of inspiration by helping to fix the origin of the diaphragm. If the thorax and vertebral column are fixed, it may act upon the pelvis, raising it toward its own side when only one muscle is put in action, and when both muscles act together either from below or above they flex the trunk.

Now if the thorax, spine, and pelvis are all three fixed and a force is applied to the muscle, it is evident that something must give, and a fracture of the transverse process, a separation of a lumbar rib, or a separation of the twelfth rib, or a combination of these, results.

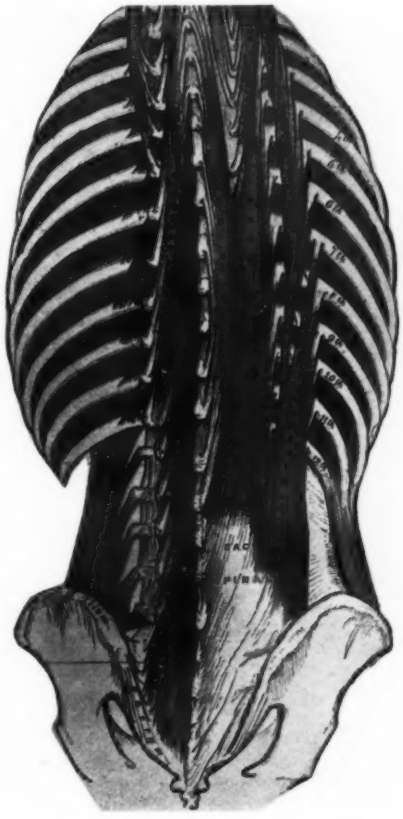


Fig. 3. Showing the quadratus lumborum with its origin from the pelvis and insertion into the tips of the transverse processes and into the last rib. (Gray's *Anatomy.*)

Fig. 4. Case 1, showing fracture of the first, second, third, fourth, and fifth lumbar transverse processes on the right side with marked diastasis and fracture of the first on the left side. Age 33. Cause: severe contusion.

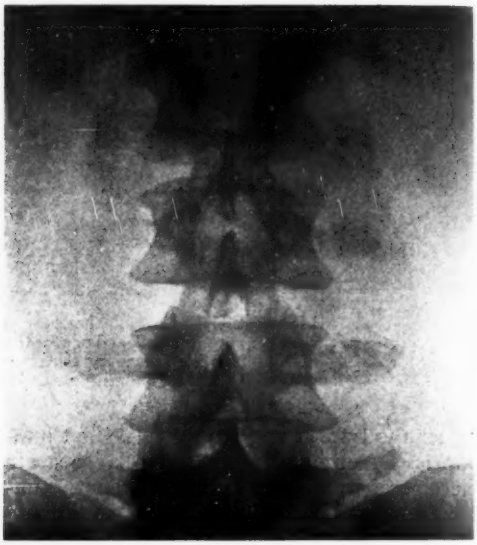


Fig. 5. Case 2, showing fracture of the transverse processes of the first, second, third, fourth, and fifth lumbar vertebræ on the right side. The first lumbar process has taken on the form of a lumbar rib and is dislocated from its normal position. Age 40. Cause: contusion.

That is by indirect violence. And it is the writer's opinion that practically all of these fractures occur in this manner.

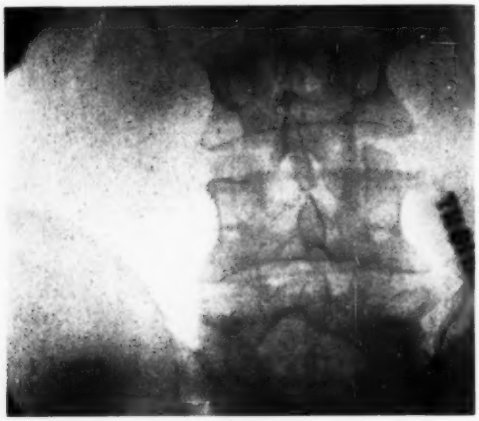


Fig. 6. Case 3, showing fracture of the second, third, fourth, and fifth lumbar transverse processes on the right side and osteo-arthritis (lipping) of the third and fourth lumbar vertebræ. Age 52. Cause: contusion.

Fig. 7. Case 4, showing fracture of the left transverse process of the fourth lumbar vertebra and osteo-arthritis (lipping) of the second, third, and fourth lumbar vertebræ and a fracture of the lipping of the upper left border of the body of the fourth lumbar vertebra. Age 46. Cause: severe contusion.

Fig. 8. Case 5, showing fracture of the right fourth lumbar transverse process with but slight diastasis. Age 54. Cause: contusion of back.

If the patient is under 25 years of age, it is possible that the secondary ossific centers present a *locus minoris resistentiæ* at their union with the primary ossific centers of the transverse process. However, the 10 cases

Fig. 9. Case 6, showing linear fracture of the left second and third lumbar transverse processes. Age 41. Cause: a severe squeeze of the back.

that are reported in this paper are respectively 33, 40, 52, 46, 54, 41, 23, 48, 30, and 39 years old; the youngest 23, the oldest 54, and averaging 40 years plus. Evidently in these cases it was not a question of separation of ossific centers.

In two of these 10 cases, 1 and 8, there were bilateral fractures of the transverse processes; in Case 1 on the right side all five processes and on the left the first were fractured. In

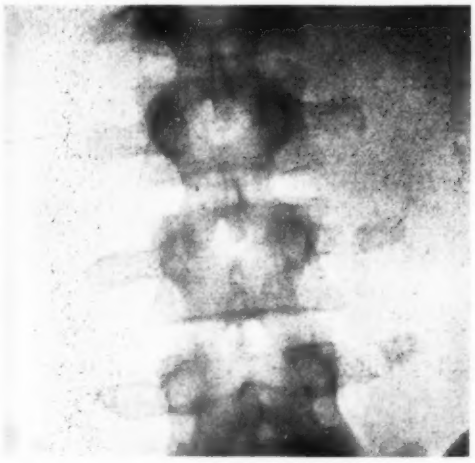


Fig. 10. Case 7, showing fracture of the transverse processes of the right side of the third and fourth lumbar vertebræ. Age 23. Cause: contusion of back.

Fig. 11. Case 8, showing fracture of the transverse processes of the lumbar vertebræ, right side third and fourth and left side fourth; associated osteo-arthritis, lipping, of the third and fourth lumbar vertebræ with fracture of the tip of body of the fourth vertebra, left upper border. Age 48. Cause: contusion of back.

Fig. 12. Case 9 showing fracture of the left transverse process of the second lumbar vertebra. Age 39. Cause: injured by a fall of slate in a mine.

Case 8 on the right side the third and fourth and on the left the fourth processes were fractured. And in both of these cases there was no injury to the spinous processes. Both cases were the result of heavy weights injuring the lumbar region. Thus it is not conceivable that a force could strike the transverse processes on one side and fracture them and then shift the weight to the opposite side and fracture the others without involving the intervening spinous processes. The answer is that the force was placed upon the quadratus lumborum and fracture resulted from muscular pull, or indirect violence.

The symptomatology of these injuries is definite. Pain in the back, "backache," is the chief symptom. The pain is well localized, constant, and does not radiate. It is exaggerated by any motion that changes the line of the weight of the body. Rising from the incumbent to the sitting position and from the sitting to the erect position increases the pain. In no position other than lying relaxed in bed is the patient free from pain. Flexion and hyperextension of the spine, and lateral bending, both toward and from the injured side, cause pain. Bending toward the injured side sometimes causes more pain than bending from the injured side. Muscular rigidity and a point of exquisite tenderness over the fractured processes are noted. This pain in

Fig. 13. Case 10, showing fracture of the right transverse processes of the first, second, and third lumbar vertebræ and dislocation of the right twelfth rib, and compression fracture of the first lumbar vertebra. Age 39. Cause: patient was "buckled" in a coal slide in mine.

the back is not accompanied by any neurological symptoms. In some cases, however, these symptoms, though present, are of such a slight degree that the patient goes back to his occupation in a few weeks having but slight complaint. This, however, is not the rule.

X-ray examination of these cases may show a linear fracture with the fragment in good position. More often, however, there is considerable diastasis of the fragments. If there is a lumbar rib (Fig. 5, Case 2) this may be seen dislocated from its articulation with the spine or the same may be true of the twelfth rib (Fig. 13, Case 10). In the writer's cases osteo-arthritis of the body of the vertebra was associated with fractures of the process in three of the patients (Figs. 6, 7, and 11).

The diagnosis is made by the history of a fall or injury to the back resulting in an area of localized tenderness, lateral to the median line of the spine. As is the case in diagnosis of fractures of long bones this localized tenderness is the most reliable sign. X-ray, of course, will show the fractures. Many cases which would not be recognized by the

X-ray have doubtlessly been overlooked and considered only as sprains.

CONCLUSIONS

Indirect violence plays the most important rôle in these fractures.

The occurrence is noted in patients of advanced years, men beyond the age in which we would expect separation of the secondary ossific centers from the primary ossific centers of the transverse processes.

The condition is often associated with osteoarthritis.

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CAVERNOUS HÆMANGIOMA OF LEFT LOBE OF LIVER

WEIGHT THREE POUNDS FOURTEEN OUNCES; EXTIRPATION OF LEFT LOBE OF LIVER; RECOVERY[1]

BY CHARLES H. PECK, M.D., F.A.C.S., NEW YORK
Surgeon, Roosevelt Hospital

CAVERNOUS hæmangioma of the liver is a relatively rare condition, though a review of the literature shows a number of examples, both autopsy and operative reports. The following case seems of sufficient interest to be worthy of record.

Mrs. G. W., age 34; born in Russia; married; one child; came to this country at the age of 21. No previous history of any moment. For about one year prior to operation she had not felt well, had vague discomfort in abdomen with occasional pain, and noticed gradual enlargement of abdomen; was troubled with gas and indigestion; bowels became constipated; and lost about 22 pounds in weight. Symptoms have become more marked for the past 3 or 4 months. Physical examination first made by her physician, Dr. J. W. Weinstein, 4 months ago, showed a large, soft, movable tumor in the epigastrium, extending from the ensiform cartilage to the umbilicus; smooth surfaced, elastic, insensitive. Blood pressure, urine, and gastric contents were all practically normal. X-ray showed the stomach displaced markedly to the left, in a vertical position, its lesser curvature lying against the left border of the tumor. The mass was diagnosed as pancreatic cyst. It enlarged slowly while under the observation of her physician, but did not change in position or consistence. Examination, October 20, 1920, was practically as noted, and the diagnosis of the pancreatic cyst was accepted, though there seemed to be rather unusual lateral mobility for such a cyst. Operation was performed on October 22, 1920, at the Roosevelt Hospital. The mass presented was of deep purplish color, smooth surfaced, soft and elastic, free from adhesions. Above, it had a flat, broad pedicle, which, on examination, proved to be the stretched-out coronary ligament of the left lobe of the liver. Below, across its rounded margin, ran a remnant of the sharp edge of the left lobe. The right lobe of liver, gall-bladder, and ducts were quite normal. Examination of the other abdominal organs, pancreas, spleen, kidneys, stomach and intestinal tract, and pelvic organs was negative. Its attachment with the right lobe had been thinned, as had its whole pedicle, undoubtedly by the drag caused by its weight. It was at once evident that it was a lesion of the liver itself and not of the pancreas. It was thought to be probably some form of cyst and total excision was decided upon and performed without great difficulty. The vessels in the pedicle were secured by clamp and ligature, as it was divided step by step, and the mass was removed. The cut edges of the coronary ligaments on the under surface of the diaphragm were sutured with continuous catgut covering the wound surface between and completing hæmostasis. It weighed 3 pounds 14 ounces (1,750 grams) and included the entire left lobe. It was not sectioned at once, as we wished to obtain measurements, weight, and photographs. A day or two later when cut it proved to be a solid mass and not a cyst. Microscopic sections showed this to be a typical cavernous hæmangioma with much destruction of liver tissue and its replacement by the branching blood spaces and fibrous tissue.

The patient made a good recovery and the wound healed kindly by primary union. Convalescence was interrupted by symptoms of a pulmonary infarct on November 12, 1920. There was sharp pain in the left thorax, cough, blood-tinged expectoration, and a rise of temperature. These symptoms continued 3 or 4 days, abating slowly, when another similar attack occurred. This was repeated in all three times.

[1] Read before the Southern Surgical Association, Hot Springs, Virginia, December 14-16, 1920.

Fig. 1. Photograph showing anterior surface of tumor, remnant of sharp edge of left lobe, and denuded area which lay between folds of coronary ligament at upper margin.

X-ray of the chest failed to visualize any infarct or area of consolidation. There was also noted, about November 9, 1920, a slight phlebitis of the right leg and calf. This was quite mild in type and subsided in a few days time. The patient was discharged from the hospital on the thirty-second day after operation and is now quite well.

Pathological report. Specimen: Entire left lobe of liver.

Fig. 2. Photograph of tumor cut and laid open.

Microscopic examination. Specimen consists of a large rounded cystic feeling mass, of color of liver tissue, measuring 26 by 20 by 9 centimeters and weighing 3 pounds 14 ounces. It is covered by peritoneum which is smooth and glistening, with the exception of one portion, oval in shape, measuring about 14 by 7 centimeters, where mass was dissected from diaphragm. Quite numerous, moderate-sized veins can be seen running under the capsule. The entire mass is soft and apparently contains fluid. At one border is a small tag of normal appearing liver tissue, which is firm, and on section has structure of liver. After hardening for several days, the mass was sectioned. Cut section shows a red, homogeneous surface, apparently very hæmorrhagic, in which

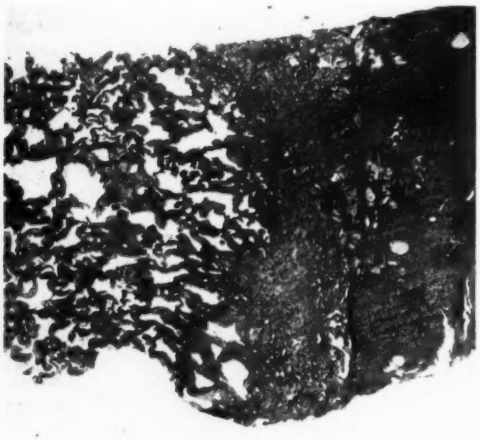

Fig. 3. Microphotograph, low power, showing tissue of hæmangioma to the left, and liver tissue comparatively unchanged to the right.

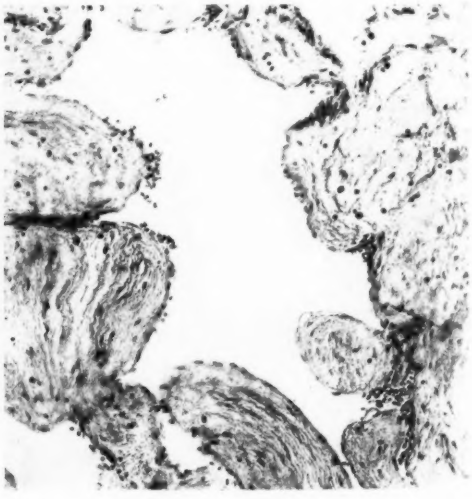

Fig. 4. Microphotograph, high power, showing structure of fibrous septa and endothelial lining of large cavernous spaces.

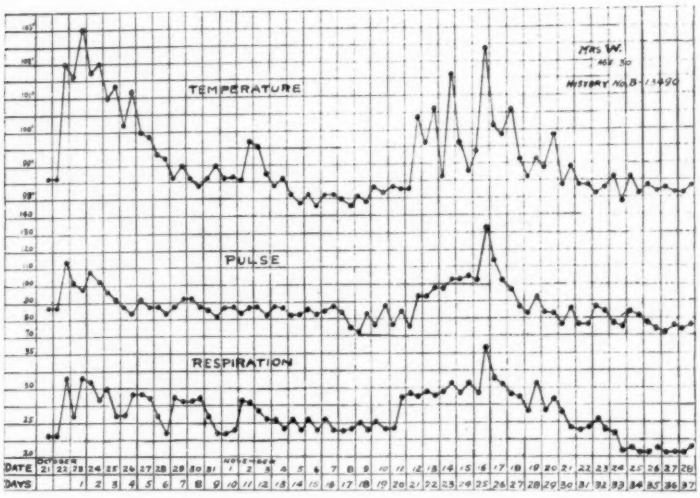

Fig. 5. Temperature chart. Moderate operative reaction. Recrudescence of fever corresponding to pulmonary infarcts during convalescence.

white, irregular islands and strands of tissue can be seen in large number. These are firm, while rest of tissue is soft and very bloody. After several more days in formalin, much of semi-fluid content of mass is drained out and the cut surface has a definite spongy appearance, from which fluid can be squeezed and which will again take up fluid.

Section I shows portion of large fibrous bundle to be made up of fibrous connective tissue. From this septa pass out in various directions. Between these septa are masses of red blood cells.

The septa are composed of connective tissue and the surfaces are lined with a layer of flattened cells, resembling endothelium. The section of liver tissue looks normal.

Diagnosis: Cavernous hamangioma of left lobe of liver.

This report was made by Dr. William C. White, surgical pathologist to the Roosevelt Hospital, and confirmed by the Department of Surgical Pathology at the College of Physicians and Surgeons, Columbia University.

McCallum (1) cites briefly a large pedunculated angioma, 24 centimeters in diameter, hung by a stalk from the right lobe of the liver, weight not given. Major and Black (2) report the largest tumor on record, 18,160 grams (37 pounds), 49 per cent of the total body weight, at the time of death.

The tendency of these tumors seems to be to attain large size before proving fatal.

Fig. 6. Photograph of patient taken November 28, 1920, 37 days after operation. A mass weighing 3 pounds, 14 ounces, and including the entire left lobe of the liver, was removed.

Mantle (3) performed exploratory laparotomy for a huge hæmangioma of the right lobe, 12 inches by 6.5 inches in diameter. The patient died within 2 hours from hæmorrhage following needle puncture of the tumor and subsequent ineffectual attempts to control the bleeding by sutures and packing.

Chiara (4) reports a case operated on by Freund of rupture of an enormous angioma of the left lobe during exploratory laparotomy with death from hæmorrhage within an hour. We have been able to collect records of 21 operative cases, in 17 of which the tumor was excised with 15 recoveries and 2 deaths. Of the whole number, 15 were females and 6 males. The left lobe was most frequently affected, the tumor being situated in the left lobe in 11 cases, the right lobe in 7, Spigelian 1, multiple tumors 1, site not stated, 1. The largest case excised was that of Pfannenstiel (5), reported also by Langer (5), in which the collapsed growth weighed 5 pounds and the estimated weight, before the blood escaped, was 10 pounds. The patient made a good recovery ultimately, though the operative hæmorrhage was great.

Keen (6) reports an interesting case, in which he formed an artificial pedicle by incising the liver on either side of the growth, then applying an elastic ligature and packing the wound open. The means of controlling hæmorrhage, reported by various operators, have been the elastic ligature, chain ligatures through pedicles, and use of the cautery and packing. In some of the cases, as in my own, the tendency to pedunculation of the tumor facilitated its removal, without great loss of blood. This tendency is evidently due to the weight of the tumor exerting a constant drag on the soft liver tissue and weak ligaments. On the other hand, excision of cases with broad attachments to the liver has been difficult and accompanied by serious hæmorrhage. Incision into, or even needle puncture of the tumor, has proved exceedingly dangerous and even fatal in some of the reported cases. I believe our own case to be the largest tumor successfully excised in this country, and the second largest successful excision reported, the largest being the case of Pfannenstiel.

No attempt has been made to review completely reports of non-operative cases.

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LINITIS PLASTICA[1]

By E. PAYNE PALMER, M.D., F.A.C.S.; W. WARNER WATKINS, M.D.; and HARLAN P. MILLS, M.D.,
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THIS disease has been given a different name by almost every writer on the subject. The following are some of them: linitis plastica hypertrophica; stenotic hypertrophic gastritis; cirrhosis of the stomach; Brinton's disease; cryptogenetic granulomatosis of the stomach; leather bottle stomach; fibroid induration of the stomach; gastric sclerosis; endogastritis obliterans; *Zuckergussmagen; Magenschrumpfung.*

Linitis plastica was first studied by Andral, and named linitis plastica hypertrophica by Brinton in 1854. It is a disease entity, affecting the stomach and, very rarely, the small and large intestines, spreading to the adjacent structures by continuity.

In this paper we will deal with the affection of the stomach only. Linitis plastica is a disease of the stomach, producing diffuse and marked hypertrophy of the submucous connective tissue, and, to a lesser degree, of all of the coats except the mucosa, where there is an atrophy of the glandular elements. The stomach walls are markedly thickened, usually from six to eight times the normal thickness, and are rigid and hard like a leather bag, with a diminution of the lumen. The wall at the pylorus is much thicker, harder and more glistening than that toward the cardia. The chief characteristics of the affection are a slow, progressive stenosis of the stomach, resulting in food stagnation, and often a perceptible tumor in the epigastric region, with an absence of pain, hæmorrhage and early vomiting.

There are two forms of the disease: the localized and the diffuse. The localized is usually situated at or near the pylorus; the diffuse commences at or near the pylorus and extends toward the cardia and may involve all of the stomach. The disease does not extend into the duodenum, and here the contrast is very noticeable and of great diagnostic value. When the abdomen is opened, a characteristic picture is seen; the stomach is cylindrical in shape, the surface is smooth, with a dull, pearly white peritoneum. The interlacing strands of fibrous tissue are plainly seen beneath the peritoneum. Palpation shows the stomach to be hard, rigid, and thick, resembling the feeling of cartilage or contracted muscle.

The disease is classified as both benign and malignant. Morison states that over 50 per cent of the cases are carcinomatous. Lyle has collected reports of seventy benign and sixty malignant cases.

The disease is found in adults only; the greatest number of cases occurring between the ages of 40 and 60 years, and about twice as often in men as in women.

HISTOPATHOLOGY

The essential histological change would appear to be a sclerosing process, due to the formation of new fibrous tissue, chiefly in the submucous and subserous layers, but also infiltrating to a lesser degree the muscularis. The question of malignancy has been extensively discussed, some writers considering the condition benign, others finding a large percentage malignant, while Ewing concludes that all cases are primarily carcinomatous, but because of the sclerosing process the last traces of atypical epithelial structures disappear in a small percentage of cases. Though it is possible that such a process may result from purely inflammatory sclerosis, the probability is that the great majority, if not all, cases, are atypical sclerosing fibrocarcinomata. The condition apparently originates at or near the pylorus and spreads by continuity along the coats of the stomach and in a few instances also involves the duodenum and adjacent tissues, although lymph-node or distant metastases seldom occur.

SYMPTOMATOLOGY

The onset is gradual, with loss of appetite, disturbed digestion, eructation of gas, and the patients find that they must discontinue the heavier articles of diet, or they are retained

[1] Presented at the Arizona section of the Clinical Congress of American College of Surgeons, Phoenix, Arizona, November 16, 1920.

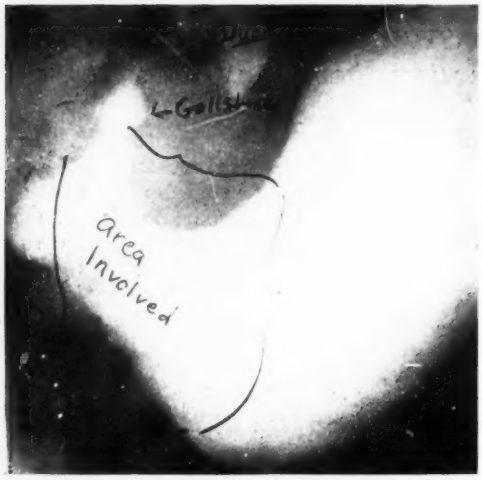

Fig. 1. Roentgenogram of stomach showing area of involvement in linitis plastica.

in the stomach and vomited. The vomiting is usually voluntary, to relieve distress. There is loss of weight and cachexia. The symptoms gradually increase in severity, so that only light liquids can be taken; finally complete stenosis results, producing death by starvation. In some cases, the obstructive symptoms appear rapidly. Examination discloses a mass in the epigastrium, which is usually freely movable except late in the disease. The mass is extremely hard, and transmits the pulsation of the abdominal aorta plainly to the palpating hand.

DIFFERENTIAL DIAGNOSIS

Linitis plastica resembles scirrhous carcinoma and cirrhotic syphilis of the stomach, and has frequently been mistaken for the former, both before and after the abdomen is opened. The large tumor gives a very unfavorable appearance, and if unrecognized, and considered to be inoperable carcinoma, the abdomen is closed or a gastro-enterostomy is done.

Linitis plastica gives a history of disturbed digestion, with a gradual decrease in the capacity of the stomach, voluntary vomiting to relieve distress, an absence of pain, and a negative Wassermann; a mass in the epigastric region can be felt, which, if the disease is advanced, is excessive in proportion to the subjective symptoms.

In carcinoma, pain is present in 90 per cent of the cases and usually occurs early. Vomiting occurs as a marked symptom in 73 per cent of the cases, and is usually involuntary, hæmatemesis or melæna occurring in 35 to 40 per cent of the cases.

Syphilis of the stomach is seen in younger patients, usually under 40 years of age. Pain caused by the taking of food is delayed in the earlier stage of the disease, and is quite prompt after meals in the later course. The pain is associated with nausea and vomiting. There is an absence of hæmorrhage and maintenance of a good appetite in the majority of cases of stomach syphilis. A positive Wassermann can usually be obtained in the acquired type and a careful history and physical examination would show other abnormalities in the congenital type.

The laboratory findings are usually not characteristic.

Capacity examination shows a diminution and the stomach cannot be distended. Test meal will show a diminution in acidity, with little or no free hydrochloric acid. The stomach frequently contains pus, and blood may be found in the stomach contents or in the stools because of the ulceration present in the majority of the cases.

Blood examination will show a secondary anæmia.

The roentgen examination offers the best means of recognizing the lesion, although the resemblance to scirrhous cancer and syphilis persists in the X-ray appearances. So long as scirrhous carcinoma and linitis plastica are used as interchangeable terms for the same lesion, a close differentiation between the two is unimportant. The X-ray differentiation of stomach syphilis is more important, but not always possible.

As stated by Carman, the roentgen-ray characteristics of linitis plastica are those of a filling defect with a relatively smooth inner margin, and with peristalsis absent from the area involved. The pylorus may be either gaping or obstructed.

When the involvement is extensive, the absence of expansibility, as seen on the fluo-

Fig. 2. Roentgenogram of gall-bladder after removal, showing the two large stones.

roscopic screen, is very striking, the stomach being small, contracted, and drawn upward.

When the involvement begins at the pylorus, early obstruction may result, in which case the stomach will appear dilated. This latter type may resemble the pyloric induration of deep ulcer, which sometimes produces obstruction. This resemblance can be all the more striking, since the indurated area of linitis is frequently ulcerated, and it is impossible to determine, except by careful microscopic examination, just what the essential tissue change is.

TREATMENT

The disease is amenable to surgical procedures only.

Gastrectomy is the operation of choice. If the patient is feeble, the two-stage operation is advisable, that is, a preliminary gastroenterostomy, and a secondary gastrectomy.

The anterior Polya is the procedure of choice, if the patient's condition will permit of a single operation. This operation can be done more rapidly, and is easier for the operator.

The mortality rate is about the same as in various other gastrectomies and there is less postoperative disturbance and greater comfort after this procedure.

If a total gastrectomy is performed, œsophagojejunal anastomosis should be done. Satisfactory results have followed this procedure.

On October 29, 1920, Mrs. L. C., married, age 65, consulted her physician because of a distress in the stomach, extending over a period of 5 to 8 years. The onset was very insidious but distress has been becoming progressively worse. First attacks frequently awakened her at night, and distress would wear off in a few hours after taking a solution of

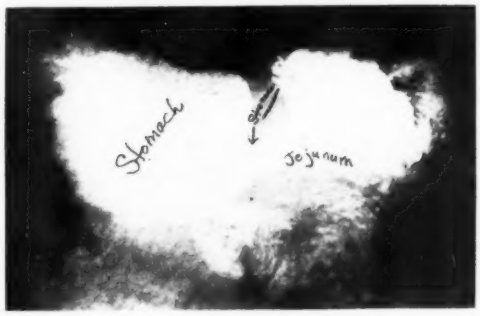

Fig. 3. Roentgenogram of stomach 2 weeks after operation.

soda bicarbonate. During the early period, the attacks occurred at intervals of many months; in the last year the attacks have become more frequent, especially during the 3 preceding months. The location of the distress was in the epigastrium, extending laterally to the upper right and left quadrants.

Family history. One niece died of tuberculosis; one sister had been operated upon for carcinoma of the uterus 7 or 8 years ago; otherwise negative.

The patient had measles and whooping cough during childhood. The periods were always regular, of the three-day type; moderate amount; no pain or discomfort. She had had two children, normal birth, accompanied by little laceration; menstruated twice after birth of last child; menopause 20 years ago.

The present trouble began about one week ago, with aching over the upper abdomen, extending laterally, voluntary vomiting, giving slight relief. The vomitus was very sour but contained no blood. The stools were not tar colored. Eructation of gas always followed taking of food. Patient avoided heavy articles of food in the hope of obtaining some relief from distress, and has limited her nourishment to light broth, finding that this is the only nourishment that she can take with any degree of comfort. Weight was normal until the past week, when she lost 10 pounds. Complains of weakness, which she attributes to lack of nourishment. She has never been confined to bed during the present or previous attacks.

Examination. Patient was well nourished. Careful physical examination disclosed no abnormality except a large, hard, movable tumor in the epigastric region, which transmitted pulsation of the abdominal aorta to the palpating hand. Examination of urine showed it to be normal.

Blood. Red cells, 4,360,000; white cells, 10,600. Hæmoglobin, 40 per cent; lymphocytes, 35 per cent; polymorphonuclears, 65 per cent.

X-ray examination. Stomach is narrowed and the wall is stiffened in the pyloric portion and shows no peristaltic action. This is the picture of carcinoma, and from the X-ray examination, conclusion would be that the whole pyloric third of the stom-

Fig. 4. Interior view of resected portion of stomach.
Fig. 5. Exterior view of resected portion of stomach.

ach is involved. So far as the stomach proper is concerned, this would be in the operable stage. Stomach was empty at 6 hours. Rounded protuberance from the pylorus not diagnosed at X-ray examination. (Note: This was shown by operation to be a gall-stone.) Diagnosis: Advanced carcinoma of stomach, probably operable.

Operation, November 1. A right paramedian incision was made. Exploration showed the tumor to involve pyloric and middle third of stomach. The stomach was cylindrical, with hard, thickened walls, free from adhesions and nodules. The surface was smooth, with a dull, pearl white peritoneum. The interlacing bands of fibrous tissue could be plainly seen and felt beneath the peritoneum. The thickening stopped abruptly at the pylorus. The contrast between the pylorus and the duodenum was pathognomonic of the disease. No enlarged glands were found. There was a hydrops of the gall-bladder, the bladder being unusually large, and contained two large stones. Otherwise no abnormality was found. The anterior Polya gastrectomy was performed. All of the diseased tissue was removed. Cholecystectomy was also performed.

The patient has made a most satisfactory convalescence. She was out of bed on the ninth day after the operation, and is now taking a general diet with no discomfort.

Pathology. Specimen consists of pyloric and middle portion of stomach and measures 18 centimeters along greater curvature and 9 centimeters along lesser curvature. On section, the stomach wall shows very marked thickening and induration and marked reduction of the lumen. The mucosa is thrown into excessive folds, but otherwise no marked thickening of mucosa is noted. The abnormal change is shown chiefly in the submucosa, muscularis, and subserous coats. The muscularis is seen in gross specimen to be greatly increased in depth and feels tough, elastic, and leathery. This condition of the stomach wall ends rather abruptly about 4 centimeters within the line of incision and the induration does not extend into the duodenum.

Near the pylorus is an ulcer with precipitous edges.

Microscopic sections of this area show the ulcer extending to beneath the mucosa, the floor being covered by a narrow zone of necrosis.

The mucosa adjacent to the ulcer shows an excessive amount of new formed fibrous tissue, abnormally separating the gland tubules. The submucosa is greatly thickened and fibrous. The same is true of the subserous layer. The muscular layer is also slightly thickened, due to interposed bands of dense fibrous tissue. Scattered irregularly through this fibrous tissue, from the serous border to well within the deeper portions of the gland tubules of the mucosa, are seen larger atypical cells, with deeply staining nuclei. These cells are widely separated, except that occasionally in the subserous area fairly characteristic alveoli are formed.

Sections from area farther removed from the pylorus show a similar arrangement, except that there is much less dense fibrous structure and the atypical cells are found invading to a greater extent the glandular tubules of the mucosa. In limited areas where erosion of the mucosa is present, these cells are found at the very margin. Sections from the margin farthest from the pylorus do not show carcinomatous involvement nor definite increase in fibrous structure.

X-ray post-operative findings. Barium meal fills the cardiac end of the stomach, which lies entirely to the left of the median line, with abrupt termination at stoma, the meal reappearing in the small bowel just beyond, this shadow having the typical feathery appearance of jejunum. Gastrojejunostomy with normal stoma.

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INTERSTITIAL TUBAL PREGNANCY[1]

A Report of Two Cases

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JUDGING from various statistics the occurrence of interstitial ectopic gestation is infrequent enough to warrant reporting.

The following cases are from the gynecological service of Dr. Irving S. Haynes at the Harlem Hospital.

Case 1. H. R., age 29, married, para-II; nativity—Russia; color, white; was admitted July 20, 1920, with the following history: In July, 1919, the right fallopian tube had been removed for chronic salpingitis. About 6 months prior to admission, she was curetted for a 3 months incomplete abortion. The last regular menstruation was May 27, 1920, sexual intercourse following 10 days later. The present illness began with cramps in lower abdomen 5 hours before admission. She vomited greenish fluid and gradually became weaker and pale. A laparotomy was performed shortly after admittance.

On opening the peritoneum a large amount of blood escaped; the uterus and adnexa were explored; the right tube was not found. The left tube was found normal; however, a moderate number of small follicular cysts were present in both ovaries. The body of the uterus was slightly enlarged and the seat of multiple small fibroids. On the upper aspect of the fundus, about 1 centimeter from the entrance of the fallopian tube I found a rupture which was roughly circular and about ½ centimeter in diameter, through which blood oozed freely. The left horn with the tube was removed. The embryo was looked for but was not found. The patient was discharged cured on the sixteenth day.

Pathological report. Microscopic section through rupture at cornu shows typical chorionic villi. Diagnosis: interstitial ectopic pregnancy.

Case 2. M. B., age 32, married, para-VII; nativity, U. S.; color, white; was admitted October 16, 1920, with following history: No previous operations. All her labors were difficult and in several instances were complicated by fever. The last pregnancy resulted in a 6 weeks' abortion. She was not curetted. Menstrual history—2 weeks overdue. The present illness began about 10.00 o'clock the night before admission with severe cramp-like pains in lower abdomen, more marked in the left lower quadrant and which continued until admission. She vomited several times, did not faint but gradually went into marked shock. A diagnosis of ruptured extra-uterine pregnancy was made by Dr. Brodhead.

On opening the peritoneum dark red blood escaped; the peritoneal cavity was filled with blood and blood clots. The uterus was delivered and found slightly enlarged; the left cornu had a small rupture superiorly, which was roughly circular and about 5 millimeters in diameter, through which

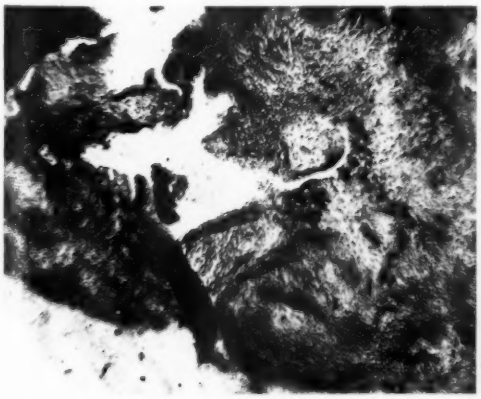

Fig. 1. Section through rupture in Case 1, showing several partly degenerated chorionic villi in partially organized blood clot.

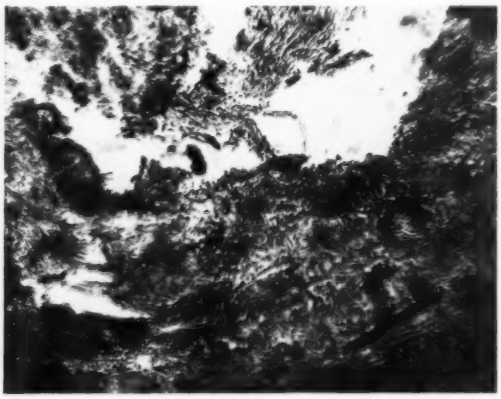

Fig. 2. Section through part of tubal lumen in Case 1, showing destruction of tube villi and lumen filled with débris of degenerated decidual cells and villi.

[1] Presented (by invitation) at the meeting of the Obstetrical and Gynecological Section of the New York Academy of Medicine, November 23, 1920.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Section through rupture in Case 2, showing typical chorionic villi.

Fig. 4. Section through lumen of tube in Case 2, showing decidual reactions in tubal villi.

Fig. 5. Section of tube in Case 2 of isthmial portion just before entering substance of uterus, showing practically a normal tube.

there was moderate bleeding. Both adnexa, with the exception of a follicular cystic right ovary, were normal. The left cornu and adnexa were removed. The embryo was looked for but was not found. The patient died on the eighth day of sepsis (anaerobic hæmolytic streptococcus isolated in blood culture). Postmortem examination revealed no peritonitis, no hæmorrhage.

Pathological report. Specimen consists of a fallopian tube about 4 inches long, showing no gross pathological change except at the uterine portion where there is a bulb-like area which, on cross section, shows hæmorrhagic area in wall and lumen.

Sections were taken from the uterine and middle portion of the tube. Microscopic section of enlarged uterine portion of the tube shows a dilated tube with the lumen filled with masses of large decidua like deep staining cells—syncytial cells and typical chorionic villi associated with moderate hæmorrhage. The section apparently bisects several levels of the tube lumen as it traverses the uterine wall and gives the picture of isolated spaces lined by glandular epithelium in the uterine portion of the tube.

Diagnosis: tubal interstitial ectopic gestation.

Microscopic study of the isthmic portion (middle third) of the tube shows a slightly thickened wall with distinctly patent lumen and flattened villi.

Important features connected with the cases just reported are: (1) previous history of abortion, or pregnancy complicated by fever; (2) early rupture; (3) extensive intraperitoneal hæmorrhage; (4) finding of normal adnexa. These features, in my opinion, are important as they tend to explain the course and cause of interstitial ectopic pregnancy.

In reviewing the literature, where a previous history of the patient was given, in most instances a record of previous abortions or uterine infection was obtained. As a similar history was present in the cases just reported —as at the operations—I found the affected and opposite fallopian tubes normal, and as others made the same observations my opinion coincides with that of Farrar in ascribing the cause, except in rare instances, to a previous low grade inflammation of the uterus. This inflammation, while severe enough to affect only a portion of interstitial tube and damaging its lumen to such an extent as to prevent the ovum entering the uterine cavity, yet is not enough to hinder the entrance of the spermatozoa. In cases reported by Farrar, Rose, and others, including those just presented, the rupture occurred very early in pregnancy, about the sixth week. Cases have also been reported where pregnancy went on for a longer period. I believe that the time of rupture and the amount of intraperitoneal hæmorrhage depends on the site of the implantation of the fertilized ovum and the relation of its chorion frondosum to nearby blood vessels. The interstitial portion of the fallopian tube being about 1.5 centimeters long, attachment of the ovum could take place at the uterine end, at the isthmial end, or between these two points, depending on the extent the tubal

lumen had previously been damaged. If implantation should occur near the uterine end, the possibility of an early abortion in the uterine cavity would be apparent; if at the isthmial end, by the trophoblastic action of the chorion frondosum in a place of least resistance, rupture would take place early, generally in the peritoneal cavity, occasionally in the folds of the broad ligament, depending on whether the attachment of the ovum was on the superior or inferior aspect of the tubal lumen. The hæmorrhage resulting from the erosion of arterioles, usually present at this location, would be extensive. If implantation should take place between the uterine and isthmial ends, as the thickness of the musculature of the fundus and of the uterine wall is considerable in this location, it would seem probable that before rupturing, the pregnant sac would attain a larger size, and the uterine rupture would be attended by a very extensive hæmorrhage from marked bleeding from hypertrophied blood vessels, if these be involved.

In concluding I wish to extend my thanks to Dr. Haynes, Dr. Brodhead, and the society for allowing me to present these cases; Dr. E. L'Esperance of Cornell Medical School and the House Staff of the Hospital for their kind assistance.

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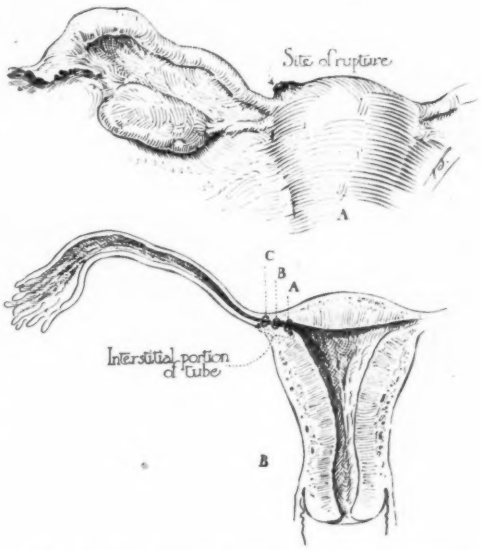

Fig. 6 (above). Schematic drawing, showing site of rupture in case reported.

Fig. 7. Diagrammatic cross section of tube and uterus, showing possible sites of nidation in interstitial part of tube at *a*, *b*, *c*.

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LAMINECTOMY FOR MENINGITIS[1]

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THE advisability of laminectomy with free spinal drainage in certain classes of meningitis is a question that seems worthy of our careful consideration. While no principle in surgery is more deservedly recognized than that of establishing an ample outlet for purulent inflammatory products, still in the cerebral and spinal inflammations we have special and very vital factors to be considered.

The cerebrospinal fluid is a most important secretion that practically forms a water bed for the small brain (1). It is estimated that the normal secretion is replaced every 3 or 4 hours by an entirely new supply and in abnormal conditions, as fracture or lumbar puncture, the alteration in normal tension may result in a very rapid increase in the normal amount of the secretion.

Acute meningitis, especially when of streptococcus or of staphylococcus origin, is a very fatal disease. Netter (2), in a study of 65 cases found that 54 died within 4 days. Death is the result of two factors: increased intracranial tension and toxæmia. The first factor can be influenced by lessening the cerebrospinal fluid by means of lumbar puncture or by the establishment of open drainage. The factor of toxæmia may possibly be influenced by the dilution of the toxins through the rapid secretion of cerebrospinal fluid.

The principle objection to laminectomy along with the operation of cerebral decompression has been made by Dr. Cushing. The objection raised is that purulent products in the base of the skull are sooner or later blocked off, thus rendering a spinal opening useless.

That this objection can not always be sustained is proved by the experimental work of Barr (3). Barr trephined a patient who had died from meningitis and then did a lumbar puncture leaving the cannula in place. The lateral ventricles were then tapped and a solution of methylene blue allowed to flow into them under low pressure. The fluid was observed to escape through the lumbar cannula showing that in this case at least the normal channels of the cerebrospinal fluid were not blocked. Barr repeated the experiment in a case he had operated on as a last resort and although the patient died, he was able to prove conclusively that the normal channels were open.

Dr. Downes reports a case of a boy of 21 who was admitted to the accident ward of the New York Hospital on November 2, 1912, suffering from a linear fracture of the left parietal region, 2½ inches long. Eight days later he developed a marked meningitis with an increased blood pressure, Kernig's sign, and marked leucocytosis. Occipital decompression was done without delay. A bone flap 3½ inches by 2½ inches with its base just above the foramen magnum was made with a Kenyon saw and turned down, exposing the posterior lobes of the cerebrum and cerebellum. The dura over the cerebrum was incised on both sides. There was an escape of ½ ounce of fluid from the left side. Incision was made through the dura of the cerebellum and some fluid escaped. Rubber dam drains were inserted and brought out through drill holes at the angles of the bone flap which was replaced. Within 24 hours the rigidity of the neck had disappeared, blood pressure was 110, and the patient very much better. The drains were removed on the second day and convalescence was uninterrupted. Cultures made from the fluid found in the dura were entirely negative.

Dr. William E. Leighton, of St. Louis (4), has done laminectomy in 4 cases of streptococcus meningitis with recovery in two of them.

It has been my privilege to operate on 2 cases of meningitis with one recovery and one death. Owing to the rarity of successful operations in these conditions, I have deemed my 2 cases worthy of report.

CASE 1. My first patient was G. W. H., white, American widower, age 40, a very powerfully built man in the prime of life.

[1] Read before the meeting of the Western Surgical Association, Los Angeles, December 3-4, 1920.

On April 28, 1918, while watching a fire in Columbus, Georgia, a cartridge in the burning building was exploded and the bullet struck him just above and to the inner side of the left eye. It ranged backward and inward and lodged in the cribriform plate of the ethmoid. He was not seriously incapacitated at the time and came to St. Louis and presented himself at my office for examination a few days after the injury.

There was an open wound in the upper and inner margin of the left orbit, and a radiographic examination showed that a bullet of thirty-eight caliber had lodged in the cribriform cells of the ethmoid.

On May 6, 1919, I operated to remove the bullet. The patient was given ether and the wound was opened sufficiently to admit the little finger. Some bone spicula were removed but the bullet could not be located until we removed the patient to the X-ray room and worked directly under the fluoroscope. The bullet was then extracted in probably not more than a minute. It was found that the orbital plate was broken and a small piece of bone came away with a little brain tissue. The skin was closed with a running suture of catgut except at the point of insertion of the rubber dam drain. Convalescence was perfectly normal until May 14, when the patient got out of bed although strictly enjoined not to do so.

On May 15, spinal fluid started leaking from the wound. The temperature which had been normal, rose to 101°, pulse 84, respiration 22.

On May 17, the temperature became normal and leakage stopped. The patient complained of a peculiar buzzing in the head.

On May 19, cerebrospinal fluid started to leak from the nose.

On May 21, patient had chilly feelings with rise of temperature to 101°. There was the most intense headache and rigidity in the back of the neck, head being absolutely fixed and thrown back. The meningitis was as marked as I had ever seen it. Kernig's sign was present. The pupils were small and there was active delirium. Blood pressure was markedly increased.

Spinal puncture was done, and the fluid found loaded with pus. The pus showed presence of diplococci and staphylococci.

On May 22 laminectomy was performed under ether anæsthesia. The spinous process and lamina of the third and fourth lumbar vertebræ were removed. The dura was exposed for about 1 inch with an area about ½ inch wide. This was incised and a large amount of purulent fluid escaped. A section of the dura mater about ¼ inch wide was cut away and a rubber dam drain inserted at the bottom of the wound.

The highest subsequent temperature was 102.8°, pulse 96, respiration 36. Patient was in a stupor and mentally incoherent for 8 days.

On May 30, the rigidity of the neck had disappeared and the drain was removed.

On May 31, temperature was normal for the first time. The headache had disappeared, but he was still somewhat irrational.

By June 6, all the mental symptoms had disappeared and he was perfectly normal.

On June 7 he had a slight chill and a violent headache with a temperature of 101. This, however, proved transient and lasted but a few hours.

On June 20 he was allowed to sit up in the chair. From this time on his improvement was rapid and he left the hospital the last of June. He kept gaining in weight and strength and resumed his regular duties as vice-president and active manager on one of our largest construction companies. He did not suffer any discomfort, pain, or anything to indicate that he had been ill. The spinal incision was perfectly healed and he does not seem to have any tendency to hernia. In November, 1919, without any warning he had what seemed to be an epileptic attack. This disappeared in a few minutes and he has had no further trouble. Up to the time of the epileptic attack he used alcohol quite freely but since then has absolutely abstained. On November 13, 1920, he reports being perfectly well.

CASE 2. The second case I wish to report is that of Mr. F. J., white, American, married, age 27, an employe of the Wabash railway.

His case was referred from the services of one of our most efficient nose and throat men, Dr. M. F. Arbuckle. He came into Dr. Arbuckle's hands on September 27, 1919. At that time he complained of pain in the left ear for several days. The first examination disclosed numerous hæmatomata on the drum. The drum was bulging and there was extreme tenderness of the mastoid antrum. Great quantities of pus were coming from the nasal accessory sinuses. The drum was incised on October 9, and there was very free discharge of pus. The local symptoms in the ear and nose then improved very markedly. The tenderness of the bone also disappeared but the patient had an intermittent fever that led to a special examination of the chest and abdomen. Nothing, however, was found. Gradual but slow improvement resulted, and at the end of 2 or 3 weeks the patient was able to come to the office. A discharge from the ear and mouth was still very copious and thick and yellow in character.

On October 23, mastoid tenderness and high fever developed and Dr. Arbuckle was called to the house. He made a diagnosis of meningitis and sent the patient to the hospital on October 24. The temperature on admission was 99.2°, pulse 86. There was tenderness over the mastoid and pain in the back and muscles of the leg. This was associated with marked headache and an elevation of temperature to 102°. The pulse increased to 118. The urinalysis was negative. Unfortunately, no blood count was made. On October 25 spinal puncture disclosed 3 ounces of spinal fluid under pressure.

There was an examination by the National Laboratory which reported that the smear contained no

organisms. There was a high cell count with a polymorphonuclear. Apparently cultures were not made.

On October 25, Dr. Arbuckle did a simple mastoid operation and pus was found present in the mastoid cells. Flexner serum was injected on October 27. Before giving this serum another spinal puncture was done. The fluid drawn from this was cloudy and the cultures made from it were negative.

On October 28 I was called in consultation. The patient was found suffering from a profound meningitis and in a state of moderate stupor, and only semiconscious. He had all the symptoms of meningitis. Temperature was 101.4°, pulse 134.

After consultation we decided that laminectomy offered the best and probably the only possible chance of recovery. Laminectomy was done in the region of the second and third lumbar vertebræ. On opening the dura we were surprised to see only two or three drops of rather turbid fluid escape. An instrument with a blunt point was then inserted upward in the dural cavity. Some dense adhesions were encountered and when these were penetrated we were astonished to see a gush of pure whitish pus that must have been as much as 20 cubic centimeters. Unfortunately, no culture tubes were available so the value of the examination of this fluid was lost. The fact, however, that we had to open through some adhesions before the pus escaped freely shows how readily pus may become walled off in the spinal canal. This would naturally lead to the inference that if operation is to be done it should be done early.

A rubber dam drain was inserted down to the dura and the wound closed. As this operation was done in a small hospital away from the city I did not get an opportunity to see the patient again. The temperature dropped down to less than 100°, and the drainage was very free. The patient, however, was restless and delirious and he died at 7:00 a.m. on morning of the 30th, 2 days after operation.

I believe in cases of meningitis from streptococcus or staphylococcus, operation should be done. Whether or not it will be found advisable in those cases of meningitis following influenza seems an open question.

I have known a few of these cases to be operated upon but have never known one to be operated upon early nor have I known a recovery to follow laminectomy in any of them. Recovery has followed repeated spinal puncture, and it does seem only rational that laminectomy should yield infinitely better results than spinal puncture if done before the cerebrospinal channels are blocked by inflammatory products or adhesions.

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THE TWO-FLAP LOW INCISION CÆSAREAN SECTION

An Operation Applicable After an Efficient Test of Labor[1]

By ALFRED C. BECK, M.D., Brooklyn

THE maternal mortality following the classical cæsarean section, when it is done late in labor, subsequent to the rupture of the membranes and examination through the vagina, is so high that most operators are unwilling to attempt suprapubic delivery after an efficient test of labor. This fear is justified by the frequent occurrence of peritonitis, which, as many writers have shown, is the usual cause of death in these cases.

Our experience has been fully as unfortunate as that of most obstetricians. In a previous review of the cæsarean sections done at the Long Island College Hospital it was shown that peritonitis caused the death of over 10 per cent of the patients operated upon after a test of labor. In these fatal cases the clinical course following operation was similar to that observed in puerperal infections until the seventh or eighth day, at which time death occurred from peritonitis. The picture was one of an "abdominal calamity" developing suddenly in the course of a puerperal infection. At autopsy we found either a stitch abscess in the uterus or a broken down wound through which contaminated material from the infected uterus escaped into the peritoneal cavity.

This frequency of peritonitis resulting from direct extension through the infected uterine

[1] Read before the Section on Obstetrics of the New York Academy of Medicine, February, 1920.

Fig. 1.

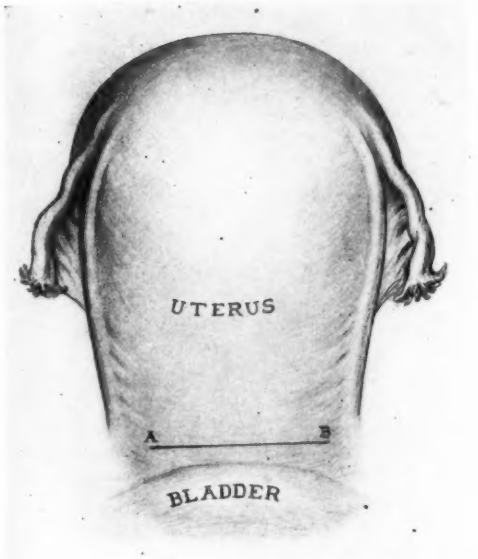
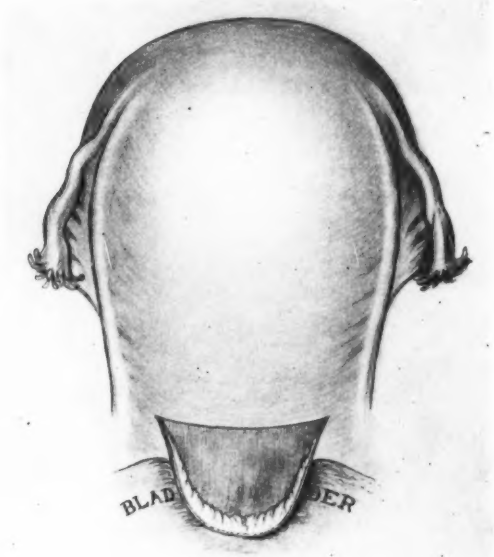


Fig. 2.



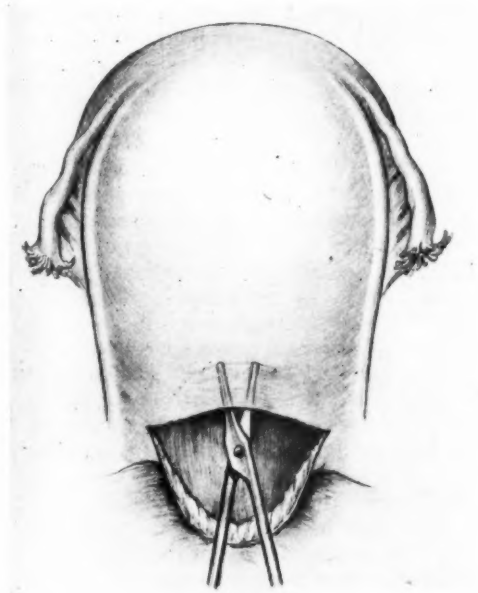


Fig. 3.

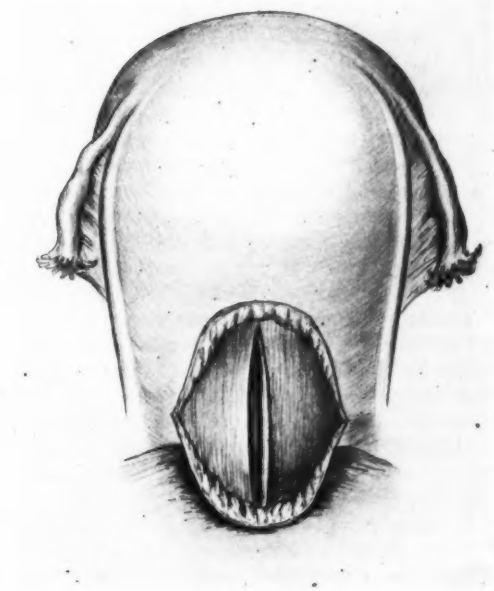


Fig. 4.

Fig. 1. The peritoneum is incised transversely about 2 centimeters above the bladder.
Fig. 2. Showing method of obtaining inferior flap.
Fig. 3. Showing method of obtaining upper flap.
Fig. 4. Incision of uterus after exposing denuded area by retracting the two flaps.

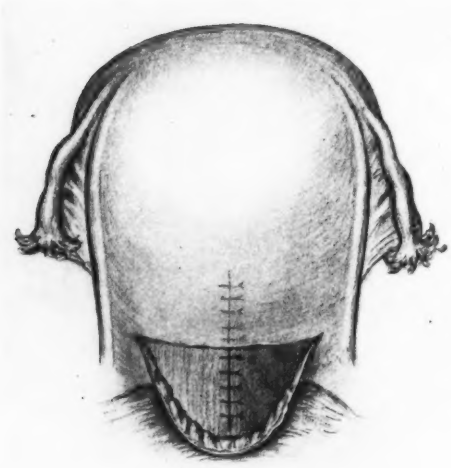


Fig. 5. The upper peritoneal flap is brought down over the superior portion of the closed uterine incision and secured by several interrupted sutures.

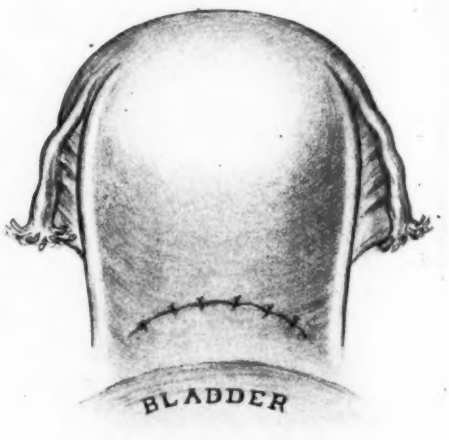


Fig. 6. The remainder of the denuded surface is covered by bringing the lower flap about 1 centimeter above the original incision.

wound, led to the search for a better method of sealing off this area. The operation which I described in the *American Journal of Obstetrics*, February, 1919, apparently gives this desired protection as it has been done 29 times by 4 operators without a fatality.

Before reporting these cases it may be well to review briefly the steps of this technique, which as may be observed is a modification of that described by Kroenig.

OPERATIVE TECHNIQUE

The uterus is exposed through a transverse or mid-line incision below the umbilicus.

The peritoneum is incised transversely about 2 centimeters above the bladder (Fig 1).

An inferior flap is obtained by stripping the bladder off from the anterior surface of the uterus, as in an abdominal hysterectomy (Fig. 2).

The upper flap is made by gently passing a pair of scissors under the peritoneum (Fig. 3).

The uterus is incised in the mid-line after exposing the denuded area by retracting the two flaps (Fig. 4).

Extraction of the child is accomplished by using one hand as a vectis, and making downward pressure on the fundus. If necessary, forceps may be used to facilitate the delivery.

Before separating and removing the placenta, a catgut traction suture is passed through the lower angle of the uterine wound, as this region of the uterus rapidly sinks into the pelvis. A similar suture is placed in the upper angle. Traction on these two sutures brings the entire wound into view and protects the peritoneal cavity from spill while the placenta and membranes are being removed. (The placenta and membranes may be forced through the cervix into the vagina.)

The incision in the uterus is closed by two series of interrupted sutures. The first passes through the entire wall down to the endometrium, while the second goes through only the outer half of the muscle wall. Each suture, in the latter or superficial series, is placed midway between the deep ones.

The upper peritoneal flap is brought down over the superior portion of the closed uterine incision and secured by several interrupted sutures (Fig. 5).

The remainder of the denuded surface is covered by bringing the lower flap about 1 centimeter above the original incision (Fig. 6).

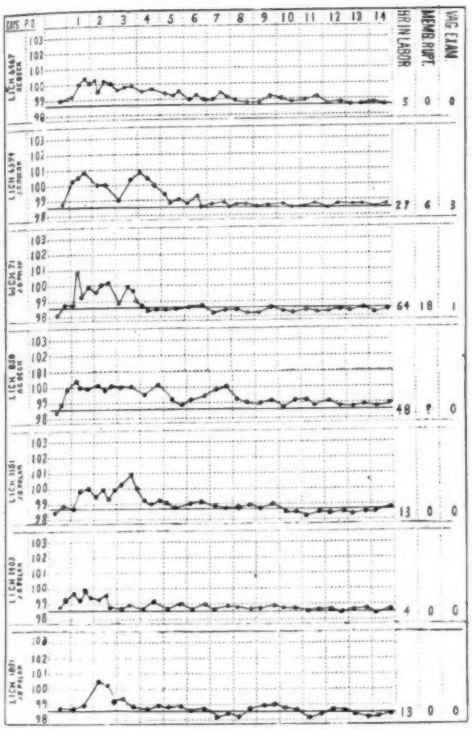


Chart 1.

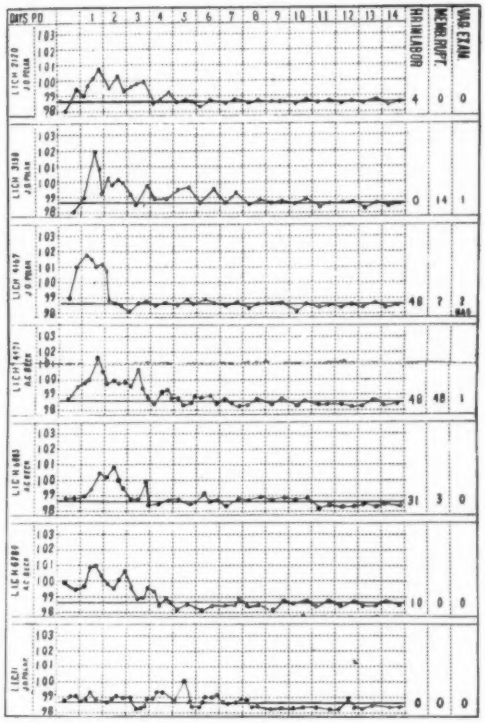


Chart 2.

In this manner the peritoneal flaps are lapped and thoroughly seal the wound in the uterus.

By placing the incision in the lower segment and doubly sealing it with peritoneum, this operation offers a two-fold barrier against the usual mode of extension of infection from the uterus to the peritoneal cavity. Because of its low site, the greater part of the incision sinks into the pelvis immediately after its closure. Localization in the pelvic peritoneum, therefore, may be anticipated should infection extend through the wound. The double flaps of peritoneum offer an added protection. Within a short time after operation, they become adherent and thereby make the uterine wound extraperitoneal. If infection occurs, they are sufficiently united by the time that the uterine wound breaks down, to protect the peritoneal cavity from contamination. Thus they limit the infection to the subperitoneal tissues, from which drainage occurs spontaneously, either through the lower angle of the abdominal incision, or through the separated edges of the uterine wound into the cervix and vagina.

The twenty-nine cases operated upon according to the above described technique are reported in the five accompanying charts. Each chart shows the temperature after operation, the number of hours elapsed since the membranes ruptured, and the number of vaginal examinations made.

Charts 1 and 2 contain the records of 14 cases in which infection probably was not present. These are shown to illustrate the absence of morbidity after the usual temperature rise that follows the trauma of most operations.

Chart 3 differs from the former in that the first three cases show some later morbidity

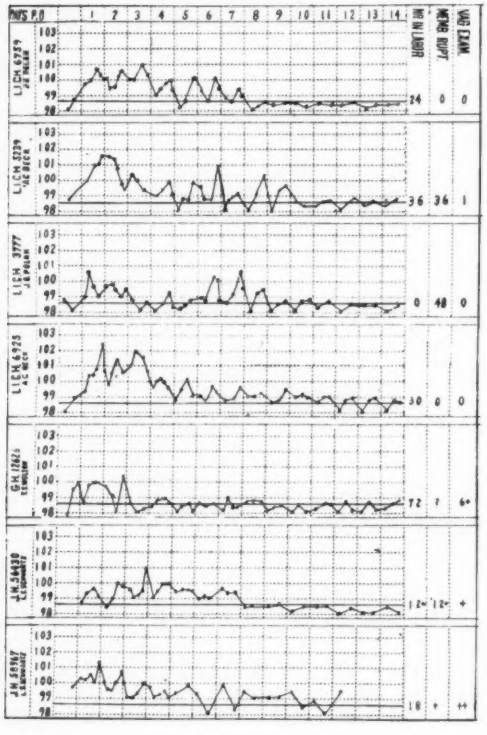


Chart 3.

which could not be explained. The rise in temperature in each case was not accompanied by an elevation of the pulse or a leucocytosis, and as a result was not attributed to infection.

Charts 4 and 5 include the pulse rate as well as the temperature. Although *uterine cultures were not made*, infection probably was present in the majority of the eight cases. None of these patients showed any signs of peritonitis, and as may be observed, instead of terminating fatally from this complication, the temperature reached normal in from 7 to 10 days after operation. Usually the fall in temperature was accompanied by, or followed shortly after, the appearance of pus in the lochia or abdominal wound.

The presence or absence of the three factors which influence morbidity and mortality following cæsarean section is shown in the three tables.

Table I.—The Duration of Labor Before Operation

Not in labor	4
3 to 10 hours in labor	4
10 to 24 hours in labor	5
24 to 36 hours in labor	9
48 hours in labor	7
Over 10 hours in labor	*21*
Over 24 hours in labor	*16*

Table II.—The Condition of the Membranes Before Operation

Membranes not ruptured	10
Membranes ruptured less than 10 hours	4
Membranes ruptured 10 to 24 hours	7
Membranes ruptured 36 to 48 hours	3
Membranes ruptured 48 hours	5
Membranes ruptured	*19*
Membranes ruptured over 10 hours	*15*
Membranes ruptured over 24 hours	*8*

Table III.—The Number of Vaginal Examinations Before Operation

No vaginal examinations	12
One vaginal examination	8
Two vaginal examinations	2
Three vaginal examinations	2
Many vaginal examinations	5
One or more vaginal examinations	*17*
Many vaginal examinations	*5*

Table I gives the duration of labor at the time of operation. Twenty-one of these patients had been in labor at least 10 hours, and sixteen had 24 hours or more of labor.

Table II shows the condition of the membranes at the time of operation. The membranes were ruptured in nineteen of the twenty-nine cases. Ten hours or more had elapsed since the rupture of the membranes in fifteen.

The number of vaginal examinations made before operation is given in Table III. Seventeen patients had one or more vaginal examinations. In five cases many examinations were noted.

One or all three of these morbidity factors was noted in twenty-five of the twenty-nine cases. While we may safely state that only four of the entire series were elective operations, it would be quite unfair to claim that all of the remainder were potentially infected, as the definition of this term is susceptible to considerable variation. However, allowing for the difference of opinion in this regard, most operators would have considered the majority to be in this class. The puerperium in only eight of them showed signs of infection and all recovered.

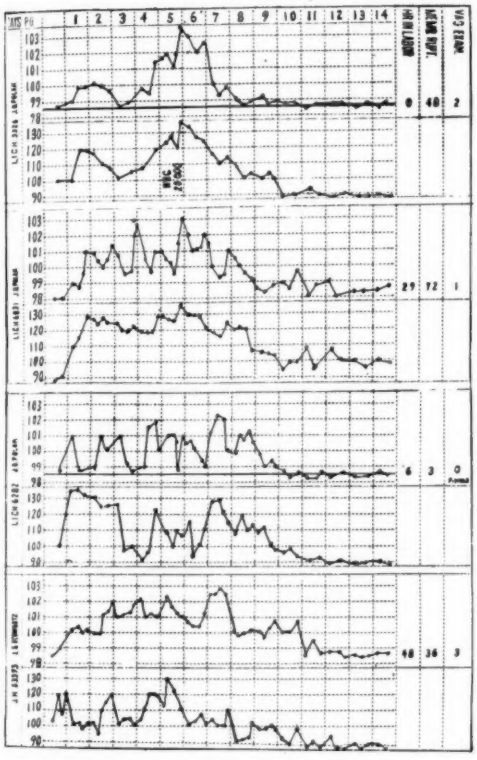


Chart 4.

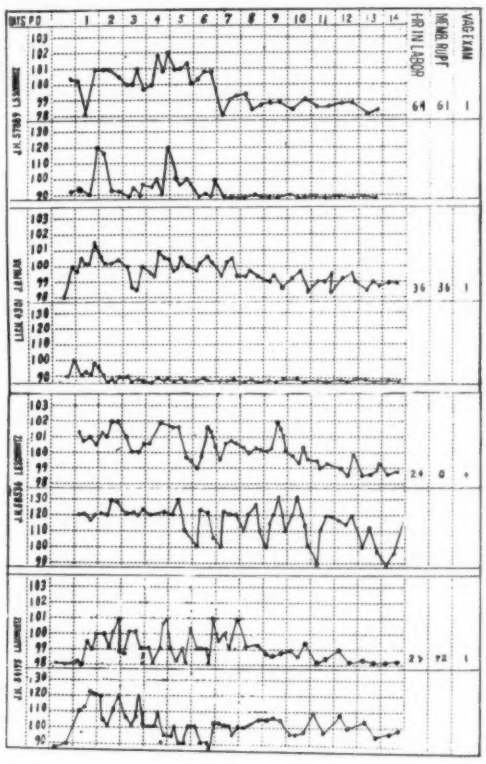


Chart 5.

These results no doubt are better than those which ultimately will be obtained in a larger series, since this technique does not protect against extension through the lymphatics and does not prevent possible contamination by the spilling of some of the amniotic fluid.

CONCLUSIONS

1. Admitting the possibility of error in attempting to draw conclusions from a small series of cases, we feel that this technique will eliminate the consideration of an elective cæsarean section in border line cases of dystocia.

2. By permitting the use of an efficient test of labor, most of these patients will be delivered through the natural passages.

3. The few that fail may with some slight added risk be delivered by the use of the above described technique.

4. So-called potentially infected cases frequently are not infected. Whenever our opinion in this respect is erroneous, our technique does not sacrifice a non-infected uterus, and thereby preserves the functions of menstruation and reproduction.

5. While our results in the infected cases are better than may be anticipated in the larger series, they indicate that the mortality will be less than 10 per cent. As this is the admitted mortality of craniotomy as well as hysterectomy following cæsarean section in this class of cases, it would seem that the two-flap, low incision cæsarean section should be given the preference in all cases in which the child is alive.

I wish to thank Drs. J. O. Polak, T. S. Welton, and L. S. Schwartz, for the use of their records in the preparation of this paper.

DANGEROUS INTRAPERITONEAL HÆMORRHAGE FROM UTERINE FIBROID

By J. LOUIS RANSOHOFF, M.D., F.A.C.S., and MAX DREYFOOS, M.D., Cincinnati

IT is customary to regard uterine fibroids as benign tumors, in so far as acute life-threatening complications are concerned. The operative cure is, as a rule, one of choice, undertaken because of the size of the tumor, pressure symptoms, metrorrhagia, or that chimera so frequently mentioned and so seldom seen—malignant degeneration. Intra-abdominal hæmorrhage from uterine fibroids is an extremely rare complication. It is not even mentioned in the ordinary textbooks of gynecology. Neither Kelly nor Crossen describe it, or even mention the possibility of its occurrence. Samson (1), in his comprehensive article on the blood supply of uterine myoma, mentions the possibility of intra-abdominal hæmorrhage, but describes no case. The bleeding occurs, as a rule, from the rupture of one or more dilated superficial veins, just beneath the peritoneum. In only two of the reported cases was the bleeding arterial. Any abdominal surgeon of even moderate experience has encountered these dilated varicose veins under the peritoneum of ordinary subserous fibroids, which, if ruptured, might well cause serious and even fatal intra-abdominal hæmorrhage. It is surprising that such hæmorrhages are not far more frequent.

In his textbook on pathology, published in 1861, Rokitansky mentioned a fatal hæmorrhage from ruptured varicose veins on the surface of the small subserous fibroid. This subject attracted little attention until 1905, when Stein (2) reported a case of fatal hæmorrhage in a woman of 44. In 1910 Brunner (3) was able to collect ten authentic cases. The cause of the rupture is not infrequently external trauma, and the bleeding vein, is as a rule, located in an exposed position, either on the dome of the tumor, or in one case, resting on the bony ridge of the sacral promontory. In many cases distinct evidence of trauma was obtained.

Steinbuchel's (4) case is of particular interest from an etiological standpoint. A symptomless fibroid had been present for many months; during an abdominal massage, given with the idea of dispersing the tumor there was a sudden violent pain which persisted on and off for 10 days. This was followed by collapse, with symptoms of intra-abdominal bleeding; operation revealed a necrotic fibroid with twisted pedicle. At the base of the pedicle was a dilated bleeding vein. Hysterectomy was followed by recovery.

The case of Zweifel (5) is, too, of unusual interest. A 27-year-old primipara died suddenly of intra-abdominal hæmorrhage, 40 hours after a miscarriage. Postmortem examination revealed a tremendous intra-abdominal hæmorrhage from numerous sieve-like perforations of varicose veins on the surface of a fibroid. It is not unlikely that here a virulent streptococcus infection may have played the important etiological rôle.

In Brunner's case, a 42-year-old nurse, the rupture followed the sudden strain of lifting a patient. There was a sharp pain in the abdomen, followed by immediate collapse; operation done after 2 hours revealed a tremendous hæmorrhage; hysterectomy was followed by prompt recovery.

Jaschke's (6) case presents almost the same history. A 48-year-old wash-woman, while lifting a tub, had a sudden pain, followed by collapse. Operation done 10 hours later revealed a ruptured subperitoneal varix on the surface of the fibroid; hysterectomy was followed by death.

The etiology in Clark's (7) case was one of internal trauma. There was a subperitoneal fibroid wedged in the pelvis. The hæmorrhage was due to the erosion of a supravaginal vein from pressure on the sacral promontory. Operation was followed by a tedious convalescence accompanied by intestinal paralysis, but eventual recovery. A further case was reported by Sadlier (8), in 1913. In this case the source of the bleeding was a small ruptured

artery over the crest of the fibroid. There was no external trauma. The fact that all these cases occurred during the active sexual life of the individual is suggestive of the well known tendency of these tumors to shrink after the menopause.

It is not surprising that the diagnosis is so seldom made. In Brunner's case alone was the correct diagnosis made before operation. The extreme rarity of the condition makes the diagnosis almost impossible. There is an old saying that the most probable is always found; and who is likely to think of a condition so rare that very few surgeons even know of its existence? In the published cases various diagnoses were made: ovarian cyst with twisted pedicle, extra-uterine pregnancy, perforation of gastric ulcers, and in one case, appendicitis.

Miss W. S., aged 35, on July 10, 1920, while eating lunch, felt a sudden sharp pain in the lower part of the abdomen. There was more or less collapse, and she was taken home in an automobile. Since that time there has been continuous fever, and severe colic-like pains in the abdomen, accompanied by diarrhœa. Her family physician who first saw her made the diagnosis of appendicitis, which he later changed to uterine tumor. We saw her on the afternoon of July 13, 1920. There was a marked pallor and shallow respiration; temperature 101.4°, pulse 112. The pulse was not of good volume. Blood pressure was 110–60; leucocyte count 17,000; reds 3,500,000; hæmoglobin 50 per cent. Abdominal examination revealed a generally distended abdomen, tender to pressure. There was just over the pubes a tumor the size of a fœtal head, freely movable from side to side. Examination of this tumor caused pain. Rectal examination gave negative finding. Diagnosis: ovarian cyst with twisted pedicle. An immediate operation was done. Gas-ether anæsthesia was used. A mid-line incision was made and, on opening the abdomen, about 2 liters of free blood was found in the abdominal cavity. This blood was partly old and partly fresh. There was a large subperitoneal fibroid, which was quickly delivered into the wound. The bleeding was seen to come from two ruptured varicose veins on the anterior surface of the fibroid. During the operation the pulse became very rapid. A supravaginal hysterectomy was done, and the wound closed without drainage. While considering the advisability of a blood transfusion, the patient made so quick a postoperative recovery that this was considered unnecessary. Recovery was uneventful and she left the hospitlal at the end of 20 days. A week after leaving the hospital she developed a thrombophlebitis of the left leg, which completely subsided in the course of the following month. The specimen shows a large subperitoneal fibroid, with two ruptured varicose veins on the anterior surface.

Fibroid removed from author's case, showing two large varicose veins on anterior surface.

It is probable from the history that after the rupture of these veins and effusion of blood into the abdominal cavity, the lowering of the blood pressure allowed clots to form in the openings. The clots were probably disturbed by the operative manœuvers, so that the bleeding again began. The fever and high leucocyte count were undoubtedly due to the absorption of the blood, and more or less substantiated the diagnosis of ovarian cyst with twisted pedicle.

Just one word in the treatment of this condition. In every reported case no matter how precarious the condition of the patient, a hysterectomy was done. In a case of this kind, in a desperate condition, it would be a more simple matter to transfix and ligate the bleeding vein on either side of the opening, and do a hysterectomy at some future time, after the recovery of the patient. In a desperate case, this would certainly be a life-saving measure.

Additional case. Since writing the above Dr. Dudley W. Palmer, of Cincinnati, has had

a similar case in his practice, which he has kindly allowed us to report in this article.

Mrs. J. T. W., age 50, referred by Dr. Allyn C. Poole. Some 5 years ago the patient weighed as much as 180 pounds; weight now 165 pounds. She had "catarrhal appendicitis" 12 years ago. She had had an indirect, inguinal hernia during the past 6 years, for which she has worn a truss. She never has been pregnant. Menses were normal until 2 years ago, since which time she has had some menorrhagia and metrorrhagia; no dysmenorrhœa.

Returning from the theater she was taken with a sudden attack of severe lower abdominal pain, followed shortly by vomiting. She vomited several times in the next 6 hours; pain increased, at which time she called the family doctor, who gave a morphine hypodermic. Pulse and temperature then became normal. There was some lower abdominal tenderness and rigidity, about equal on the two sides. During the next 12 hours pain rather cramp-like continued and she had occasional spells of vomiting. The first enema resulted in a large stool, and the two subsequent enemas produced no results other than a little mucus, bile, and charcoal, which she had taken the night before for the supposed gastritis.

Consultation was asked for 18 hours after onset, and the temperature was found then to be normal; pulse 86; lower abdominal rigidity and tenderness. The abdomen was distinctly distended. On vaginal examination, a small cervical polyp, not bleeding, was discovered. We could not map out the pelvic organs because of the rigidity and tenderness. On the tentative diagnosis of a probable obstruction of the bowel, operation was advised and accepted.

Operation January 13, 1921, Christ Hospital, 24 hours after the onset of symptoms. Catheterized specimen of urine was negative. On opening the peritoneum, large quantities of fresh blood and dark blood clots welled up. Blood was everywhere present in the abdominal cavity. Upon exploration of the pelvis, both tubes and ovaries were found to be normal. Four or five subperitoneal fibroids were left in the uterus, the largest about the size of a tennis ball. Examination of the liver, spleen, and mesentery vessels did not reveal source of hæmorrhage. The stomach was distended; no ulcerated area was palpable. Upon returning to the pelvis to deliver the fibroids, a rather large varicose vein, extending over the upper surface of the largest of the fibroids, was found to be bleeding profusely. This was the only source of the abdominal bleeding discovered. A rapid subtotal hystero-bilateral-salpingo-oophorectomy was made. The postoperative course has sustained the opinion as to the source of the intraperitoneal hæmorrhage and has been normal in every way except for an excess number of gas pains the first 72 hours.

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DEPARTMENT OF TECHNIQUE

THE SURGICAL TREATMENT OF ACUTE PELVIC INFECTIONS IN WOMEN

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IT is estimated that 75 per cent of the invalidism in women arises from pelvic infection. Women suffer from pelvic, abdominal, and back pains, disorders of menstruation, constipation, and its consequent toxæmia, reflex digestive disorders and all grades of neurasthenia, and the expression of focal infection in every form—cardiac, vascular, renal, and arthritic. At intervals there are acute exacerbations showing recurrence of the original infective process within the pelvis. Such recurrences require prolonged courses of expectant treatment, and during the time of treatment there is an ever extending and encroaching pathological destruction which either causes death or confirmed invalidism. It is especially with these acute exacerbations and with the primary attacks that this paper deals, for we wish to urge earlier and more radical operative treatment.

Recurrence of pelvic abscess after drainage through the cul-de-sac has been the rule. If one operates upon such cases at a later period, he finds the pelvic mass with its pockets of so-called sterile pus. This has convinced me that puncture of the cul-de-sac drains but one of the many pus pockets in the pelvis.

As a result of unsatisfactory experience with the then approved methods of conservatism, I have been prompted to do very radical surgery on these cases instead of waiting, for then the patient either died or became a chronic invalid. However much the cul-de-sac bulges with pus, the patient is operated upon through a median lower abdominal incision, so that all diseased tissue can be examined and treated surgically. Usually the cause of failure of the non-operative or expectant plan of treatment is that one fails to follow the known surgical principles in operating within the female pelvis, and such failure results disastrously because the knife does not excise all diseased tissue and the small wick drain fails in its purpose, for the original nidus, the infection atrium, remains, the cocci increase in number and invade the lymph and blood stream, and finally the patient succumbs. Anæsthesia, surgical shock, and the opening up of fresh areas for infection and absorption without removing the source, indeed cause more deaths, and with good reason, than would be the case if these traumata were not added to tax the patient's remaining powers of resistance.

It will be seen from the series of reports and from the outline of the histories that the pus pockets by no means regularly become sterile. It is more reasonable to assume that the individual acquires a temporary immunity, and as this immunity is gradually lost there results a recurrent exacerbation of acute inflammation with a further destruction of tissue and impairment of health. Years after the onset of the infection, many of these cases will be brought to the hospital with an acute, spreading or general peritonitis. We have reported in detail two cases who, 8 years after the onset, were operated upon during an acute exacerbation with general peritonitis.

In my opinion the greatest error in the operative treatment of these cases is insufficient surgery and inadequate drainage. The principles laid down by Joe Price and his successor, Kennedy, reach the highest degree of efficiency when applied to suppurative pelvic peritonitis. It is claimed that both the morbidity and mortality consequent to radical surgery in this condition are frightful. The reverse of this is my experience, and a review of the literature on this subject contributed during the last decade is convincing that mortality and morbidity following the non-operative, the expectant plan, and the conservative-surgical is frightful indeed. It is the purpose of the essayist to express a formula crystalized by experience into a somewhat definite plan for the management of these cases.

Immediate operation is done in all cases which present the syndrome of acute surgical pelvis, if first seen within 12 hours after the onset of the infection, which is ushered in by sudden, severe, abdominal pain, nausea, vomiting, chill, elevated temperature, irritable bladder, rectal pain, con-

stipation, abdominal rigidity and tenderness, all progressive, uninterrupted, and accompanied by a definite leucocytosis. It is especially advantageous that the operation be done before the expiration of the first 12 hours; a period of safety for patients and one difficult for diagnostic differentiation with the surgeon. If first seen 12 or more hours after onset a varying period of some hours of observation is followed, during which time absolute rest is given the patient, as compatible as possible with the routine and repeated examinations. A blood count is taken to determine the resistance of the patient and the severity of the infection, bacteriological examinations are made to ascertain the type of the bacteria with which one is dealing. As a rule there are two kinds of bacteria of genital origin, the streptococcus and gonococcus, and two of intra-abdominal origin from diverticulitis or appendicitis,—the streptococcus and the colon bacillus; other admixtures of bacteria are subsequent to or coincidental with the three named. The patient herself is taken into account more considerately than the laboratory findings concerning her. The most minute and painstaking examinations are made, employing all means at one's command for determining definitely the pelvic organs involved and the degree of involvement, not omitting a search for remote, coincidental, or complicating diseases, in which X-ray and cystoscopic examinations figure prominently: the pulse and temperature are taken, noting especially disparity between them; the expression of the face is noted; the condition of the tongue; the distention of abdomen; the amount of vomiting or degree of nausea; the severity of pain; the general appearance of well-being or lack of same; the activity of skin and kidneys; the relative difficulty of obtaining bowel evacuation; the passing of gas; and the changes that each few hours bring in any or all of these. During this time, the patient is supported by proctoclysis and hypodermoclysis of saline solutions containing glucose.

In the most acute, if seen before the eighth day after the onset, operation is deferred—

1. If the condition is apparently stationary or the symptoms take a more favorable turn during the 6 or 12 hours consumed in the preliminary study of the case;

2. When the blood examination reveals a high polymorphonuclear count without an accompanying leucocytosis or in the absence of an increasing number of leucocytes, *pari passu* with the appearance of the polymorphonuclears with each subsequent three or four hour total count. This is important for a high polymorphonuclear count with a relative leucopænia indicates an intense infection in a subject with little or no resistance—one probably so overwhelmed that a fatal issue is to be expected regardless of any and all treatment;

3. From the third to the seventh day after onset—when the severity of the peritonitis is at its height and the rest method is being given a chance to have effect, as evidenced by improvement of symptoms—then the operation should be withheld in the absence of an exigency until the more acute general symptoms have subsided.

Do not defer operation—

1. In the presence of a progressive exaggeration of unfavorable symptoms during the period of rest, observation, and expectant treatment;

2. If there is sudden relief of pain with a subjective sense of improvement, accompanied by an acceleration of pulse rate and frequently by a lowering temperature, usually indicating thrombosis, or rupture of a localized abscess;

3. When there is a sudden fall in a previously high leucocyte count or a decreasing number of leucocytes and an increasing percentage of polymorphonuclears, which indicates a falling resistance;

4. When more than one week has elapsed since the onset of the infection, for the blood during this period of time will have developed in all probability a degree of immunity to the limit of its opsonic power;

5. When a mass appears in the pelvis—evidence of the localization of the infectious process by adhesions within a circumscribed area.

It is most frequently more than a week after the onset before the patient is referred to the surgeon and a pelvic mass is almost invariably found, and for such a delay of more than 12 or 24 hours for examination and preparation for operation is all that is usually required.

Laparotomy is done through a median lower incision. Abdominal pads or rolls of dry gauze pack off the non-adherent intestines and non-invaded portion of the abdominal cavity. In the course of a great many operations done on these cases, it is found that the sooner these operations are done after the onset of the infection the less dense are the adhesions, the more easily the diseased adnexa can be separated and the shorter the convalescence. The fundus of the uterus is the landmark. It is hugged by the dissecting finger in the line of cleavage between the adherent mass and the uterus, bladder and broad ligament. Blunt dissection is done, cutting only the more resistant bands until the dissecting finger reaches

the cul-de-sac; the ends of the tubes usually found on the pelvic floor are freed. From below upward, the finger sweeps laterally from the posterior surface of the uterus over the surface of the broad ligament, feels and liberates the adherent tube and ovary and lifts them into the operative field. In the intraligamentary types of abcess the adhesions of intestines and omentum to the mass are separated, the broad ligament incised between the round ligament and fallopian tube, affording access to the pyogenic wall, which may be dissected out with the finger, frequently without rupturing it. Should it appear that hysterectomy is advisable, the broad ligament is clamped close to uterus down to the reflection of bladder, the uterovesical fold is incised, and the bladder freed from the uterus and cervix by blunt dissection. In subtotal hysterectomy a cone is excised from the cervical stump, including the glands and cervical mucosa. If a total hysterectomy is to be done a tenaculum forceps catches the vagina close to the cervix and another the lower end of the cervix; the vagina is then opened between the two tenacula and cut from the cervix uteri at its reflection. The uterus is removed by incisions with knife or scissors close to the clamps on the broad ligament. The ovarian and uterine arteries are ligated individually, if exposed; if not, by mattress sutures through the broad ligament close to the clamps. If the patient is under 35 years the best ovary is left, if it is not infected. The vaginal opening is closed by a lockstitch or interrupted figure-of-eight suture of No. 2, 10 or 20 day chromic catgut. A running lockstitch of the same is carried on either side of the cut broad ligament. As soon as the clamp is removed the edges are inspected for active bleeding; additional figure-of-eight sutures are employed to effect complete hæmostasis, and the raw edges of both broad ligaments are united with a running lockstitch or interrupted mattress suture. The entire denuded portion of the pelvic floor is covered with iodoform gauze overlaid with rubber dam if denudation is extensive; if not, rubber gloves with strips of gauze run through fingers after cutting-off tips are used.

If the abscess is intraligamentary the front layer of the broad ligament only is stitched to its opposite and the posterior left free, thus making its cavity one and continuous with the denuded pelvic floor. The abdominal gauze pads are now removed and counted. The intestines are allowed to fall forward and downward touching the rubber which overlays the gauze. The omentum, which frequently has been ligated in sections on its lower border in freeing it from the mass, is carefully laid in its normal position in the abdomen, never drawn down, nor tucked around the rubber and gauze drainage. In no case is the rubber drain removed before the seventh day. Where the drain is voluminous, and this is the rule, it is simply loosened up after a week, and during the next 3 or 4 days a gradual complete removal is done. As soon as the patient is anæsthetized, hypodermoclysis of saline and glucose is commenced and 1 or 2 quarts introduced. Before the peritoneum is closed 1 or 2 quarts of hot water are given per rectum as suggested by Clarke, and the sigmoid and colon freed from kinks or twists as they are filled.

Postoperative treatment. The head of the bed is elevated, continuous proctoclysis of tap water is given for 24 hours, and thereafter of glucose, soda, and saline, interrupted every 6 hours by rectal flushing and siphonage; in the more severe cases hypodermoclysis of glucose and saline 1 quart every 8 hours is administered. When nausea and vomiting is excessive, gastric lavage is done every 6 to 8 hours. Morphine or codein with atropin is given hypodermically in sufficient doses to relieve suffering and afford rest and sleep. Water by mouth is withheld, or is given in restricted amounts, an ounce every hour until vomiting stops, when it is increased; liquid nourishment is withheld until vomiting and nausea ceases. The bowels are moved on the fourth day by purgatives and enema.

CONCLUSIONS

Failure to remove the focus of infection renders the operation relatively valueless; for when the source remains it is to be expected that the severity of the infection will increase, the contiguous structures will become involved, and remote metastases will more certainly result.

Pelvic *débridement* is urged, at least the pyogenic membranes with infected tubes, uterus, and ovaries should be removed.

Gauze packs are applied over denuded pelvic surfaces to stop oozing and to hinder capillary absorption, thus limiting further extension of the infection.

Eroded or denuded intestinal surfaces are peritonized, or overlaid with omentum.

Rubber dam covers the gauze packs and the pelvic operative field, minimizes the formation of adhesions, and drains freely and continuously.

The gauze and rubber ends are brought out through the lower end of the incision, and transfixed with a safety pin.

The abdominal incision is closed in layers and snugly around the drains.

The dressings over the incision should be voluminous, and changed as often as soiled to keep up capillary suction.

The results which have followed this plan are the saving of life, shortening to a marked degree the postoperative period of recovery, the elimination of a prolonged morbidity, the relatively earlier restoration to health and resumption of the normal activities of the woman.

SUMMARY OF CASE REPORTS

In three years ending August 1, 1920, there have been 255 pelvic inflammatory cases operated upon consecutively, with 1 death. In this series there were 80 hysterectomies, the death occurring in this class; and 76 double salpingectomies. Of those who had either one tube or one ovary, or one tube and one ovary removed there were 98. No subsequent pregnancies have occurred in this number to date.

One hundred sixty-three have been followed up, the longest period for 3 years, the shortest 4 months. Of this number 137, or 34 per cent, are cured; that is, in good physical health and free from symptoms. Eighteen, or 11.1 per cent, are improved; 8 or 4.9 per cent, not improved. In this number those are included who are not improved for other reasons; e.g., two of them are goiter cases, goiter developing since operation.

Thirty-one had double oophorectomies done. Twenty-six, or 83.5 per cent, of these were entirely cured of symptoms. Three, or 9.6 per cent, have improved. Two, or 6.9 per cent, have not improved. It is noticeable that the percentage of cures in cases who have had both ovaries removed is relatively the same as those who have had one or none removed.

Average hospital days 23.3, including one neurotic, who spent 109 days in hospital.

The case reports herewith appended are the 163 cases, whose postoperative course has been followed. They were compiled by Dr. D. H. Doherty, from my service at Burwell's Hospital and the Vaughan Memorial Hospital.

ONE HUNDRED SIXTY-THREE CASES WHOSE POSTOPERATIVE COURSE HAS BEEN FOLLOWED

Name	Operation	Days in Hospital	Result
Mrs. A. W. L.	Left salpingectomy, oophorectomy, appendectomy	17	Cured.
Mrs. G. J.	Double salpingectomy, hysterectomy, appendectomy	22	Cured.
Mrs. G. B. E.	Double salpingectomy, hysterectomy, appendectomy	28	Cured.
Mrs. D. S. McK.	Hysterectomy, left oophorectomy, (tubes and appendix removed at previous operation)	18	Cured.
Mrs. C. D.	Hysterectomy, left oophorectomy	27	Cured.
Mrs. H. W. H.	Double salpingectomy, left oophorectomy, appendectomy	27	Cured.
Mrs. I. H.	Hysterectomy, right oophorectomy, double salpingectomy	13	Cured.
Mrs. C. L. Y.	Right salpingectomy, oophorectomy, appendectomy	14	Cured.
Mrs. H. L. P.	Right salpingectomy, oophorectomy, appendectomy	18	Cured.
Mrs. E. M. P.	Double salpingectomy, right oophorectomy, appendectomy	13	Cured.
Mrs. W. C. McD.	Double salpingectomy, hysterectomy	24	Cured.
Mrs. J. K.	Double salpingectomy, appendectomy	25	Cured.
Mrs. R. S.	Hysterectomy, right oophorectomy, appendectomy	36	Improved.
Miss B. G.	Right salpingectomy, oophorectomy, appendectomy	30	Improved.
Mrs. J. W. K.	Double salpingectomy, hysterectomy	24	Cured.
Mrs. B. B.	Right salpingectomy, oophorectomy, appendectomy	18	Cured.
Miss A. F.	Double salpingectomy, hysterectomy, appendectomy	24	Not improved
Mrs. W. C. H.	Double salpingectomy, appendectomy	21	Improved.
Mrs. W. N. E.	Double salpingectomy, oophorectomy, appendectomy	16	Cured.
Mrs. E. P.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
Mrs. L. L. S.	Double salpingectomy, left oophorectomy	31	Improved.
Mrs. G. T. W.	Double salpingectomy, appendectomy	39	Improved.
Mrs. C. J. E.	Double salpingectomy, appendectomy	19	Cured.
Mrs. I. F.	Double salpingectomy, appendectomy, hysterectomy	36	Cured.
Mrs. J. M. N.	Double salpingectomy, appendectomy,	41	Improved.
Miss R. W.	Double salpingectomy, hysterectomy, left oophorectomy, appendectomy	24	Cured.
Mrs. G. W.	Right salpingectomy	19	Cured.
Mrs. J. T. T.	Double salpingectomy, appendectomy	14	Cured.
Mrs. C. W. I.	Double salpingectomy, appendectomy, hysterectomy	28	Cured.
Mrs. J. C. L.	Double salpingectomy, appendectomy, hysterectomy	24	Improved.
Mrs. W. E. B.	Double salpingectomy, hysterectomy	20	Cured.
Mrs. C. L. C.	Double salpingectomy, appendectomy	25	Improved.
Mrs. G. F. W.	Double salpingectomy	18	Cured.
Mrs. J. D. B.	Double salpingectomy, appendectomy	28	Cured.
Miss L. M.	Double salpingectomy, appendectomy	16	Improved.
Mrs. A. J. M.	Right salpingectomy, hysterectomy, appendectomy	13	Cured.

Name	Operation	Days in Hospital	Result
Mrs. F. M. D.	Double salpingectomy, hysterectomy, appendectomy	31	Cured.
Mrs. W. H. D.	Double salpingectomy, appendectomy	23	Cured.
Mrs. S. G. P.	Double salpingectomy, hysterectomy, appendectomy	32	Not improved
Mrs. H. A. W.	Double salpingectomy, hysterectomy, appendectomy	33	Cured.
Mrs. G. W. F.	Right salpingectomy, oophorectomy, appendectomy	19	Cured.
Miss E. B.	Left oophorectomy, appendectomy	17	Cured.
Mrs. W. R. W.	Double salpingectomy, hysterectomy, appendectomy	27	Cured.
Mrs. P. M. C.	Right oophorectomy, appendectomy	25	Cured.
Mrs. S. H.	Double salpingectomy, oophorectomy	24	Cured.
Mrs. O. M. R.	Double salpingectomy, appendectomy	21	Cured.
Mrs. M. B.	Double salpingectomy, appendectomy	21	Cured.
Mrs. R. L. L.	Double salpingectomy, appendectomy, left oophorectomy	26	Improved.
Mrs. F. C. K.	Left salpingectomy, oophorectomy, appendectomy	23	Not improved
Mrs. J. M. C.	Double salpingectomy, hysterectomy, appendectomy	46	Cured.
Miss M. G.	Double salpingectomy, oophorectomy, appendectomy	41	Cured.
Mrs. D. A. M.	Double salpingectomy, appendectomy	26	Improved.
Mrs. M. M. C.	Double salpingectomy, appendectomy	32	Cured.
Miss A. L. A.	Double salpingectomy, appendectomy, left oophorectomy	19	Not improved
Mrs. B. M.	Double salpingectomy, appendectomy	19	Cured.
Mrs. D. G.	Right salpingectomy, oophorectomy, appendectomy	14	Cured.
Mrs. W. R.	Right salpingectomy, oophorectomy, appendectomy	13	Cured.
Miss M. F.	Right oophorectomy, appendectomy	13	Cured.
Mrs. F. D.	Double salpingectomy, hysterectomy	15	Cured.
Miss B. D.	Double salpingectomy, hysterectomy, appendectomy	20	Improved.
Miss F. G.	Right salpingectomy, oophorectomy, appendectomy	13	Cured.
Mrs. W. K. P.	Right salpingectomy, appendectomy	23	Cured.
Mrs. C. R. C.	Left salpingectomy, oophorectomy	16	Cured.
Miss L. R.	Right salpingectomy, double oophorectomy, appendectomy	11	Cured.
Mrs. J. W. R.	Double salpingectomy, oophorectomy, hysterectomy, appendectomy	21	Cured.
Mrs. R. J.	Double salpingectomy, oophorectomy, hysterectomy, appendectomy	22	Cured.
Mrs. R. H.	Double salpingectomy, oophorectomy, appendectomy	20	Cured.
Mrs. H. A. D.	Double salpingectomy, oophorectomy, hysterectomy, appendectomy	31	Improved.
Mrs. F. W. M.	Left salpingectomy, oophorectomy, appendectomy	18	Cured.
Miss A. B. H.	Right oophorectomy, appendectomy	12	Cured.
Miss W. H.	Right oophorectomy, appendectomy	14	Improved.
Mrs. W. I. S.	Double salpingectomy, left oophorectomy, hysterectomy	31	Cured.
Mrs. L. N.	Left salpingectomy, appendectomy	15	Cured.
Mrs. J. W. O'B.	Right oophorectomy, appendectomy	18	Improved.
Mrs. J. H. B.	Double salpingectomy, right oophorectomy	21	Improved.
Mrs. T. H. B.	Double salpingectomy, hysterectomy	22	Cured.
Mrs. W. P. N.	Left oophorectomy, appendectomy	16	Cured.
Mrs. I. P.	Double salpingectomy,	16	Cured.
Mrs. J. P. N.	Double salpingectomy, oophorectomy, hysterectomy, appendectomy	24	Not improved
Mrs. E. E. H.	Double salpingectomy, hysterectomy	36	Not improved
Mrs. J. W. R.	Double salpingectomy, appendectomy	16	Cured.
Mrs. T. H. M.	Double salpingectomy, oophorectomy, hysterectomy, appendectomy	40	Cured.
Mrs. W. M.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
Mrs. J. S.	Left salpingectomy, oophorectomy, appendectomy	20	Cured.
Mrs. W. H.	Double salpingectomy, hysterectomy, appendectomy	39	Cured.
Mrs. W.H. McG.	Double salpingectomy, hysterectomy, appendectomy	14	Cured.
Miss M. C.	Double salpingectomy, left oophorectomy, appendectomy	15	Cured.
Miss O. W.	Double salpingectomy, hysterectomy, appendectomy	18	Cured.
Mrs. O. B. F.	Double salpingectomy, hysterectomy, appendectomy	23	Cured.
Mrs. E. J. P.	Double salpingectomy, left oophorectomy, appendectomy	21	Cured.
Miss A. L. B.	Right salpingectomy, oophorectomy, appendectomy	109	Not improved
Mrs. G. C. T.	Left salpingectomy, oophorectomy, appendectomy	54	Not improved
Mrs. S. E. R.	Double salpingectomy, oophorectomy, appendectomy	29	Cured.
Mrs. D. C. D.	Left salpingectomy, oophorectomy, appendectomy	30	Cured.
Miss A. B.	Double salpingectomy, hysterectomy, oophorectomy	58	Cured.
Mrs. T. E. C.	Double salpingectomy, left oophorectomy, appendectomy	41	Cured.
Mrs. N. M. S.	Double salpingectomy, right oophorectomy, appendectomy	22	Improved.
Mrs. W. H. B.	Left salpingectomy, oophorectomy	48	Cured.
Mrs. W. M. B.	Double salpingectomy, hysterectomy, appendectomy	33	Cured.
Mrs. R. N. M. G.	Double salpingectomy, appendectomy	18	Cured.
Mrs. D. G. C.	Double salpingectomy, oophorectomy, appendectomy	18	Cured.
Miss G. S.	Double salpingectomy, appendectomy	21	Improved.
Mrs. L. M. M.	Right oophorectomy. appendectomy	18	Cured.
Mrs. R. L. H.	Right salpingectomy, oophorectomy. appendectomy	23	Cured.

Name	Operation	Days in Hospital	Result
Mrs. J. A. R.	Right salpingectomy, oophorectomy, appendectomy	23	Cured.
Miss R. D.	Left salpingectomy	23	Cured.
Colored:			
D. E.	Double salpingectomy, hysterectomy, appendectomy	19	Cured.
T. A	Double salpingectomy, oophorectomy	24	Cured.
E. R	Double salpingectomy, oophorectomy	19	Cured.
L. C.	Double salpingectomy, hysterectomy, appendectomy	18	Cured.
P. W.	Double salpingectomy, oophorectomy	21	Cured.
I. B.	Double salpingectomy, oophorectomy	17	Cured.
A. L.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
M. D.	Double salpingectomy, oophorectomy	21	Cured.
P. S.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
M. G.	Double salpingectomy, oophorectomy	17	Cured.
S. R.	Double salpingectomy, oophorectomy, appendectomy	17	Cured.
L. P.	Double salpingectomy, oophorectomy, appendectomy	21	Cured.
P. S	Double salpingectomy, left oophorectomy, hysterectomy, appendectomy	21	Cured.
M. G.	Double salpingectomy, oophorectomy	17	Cured.
M. M.	Double salpingectomy, hysterectomy	21	Cured.
E. W.	Double salpingectomy, hysterectomy	23	Cured.
S. H.	Double salpingectomy, oophorectomy, appendectomy	21	Cured.
M. J.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
B. C. L.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
G. B.	Double salpingectomy, oophorectomy, appendectomy	21	Cured.
S. P.	Double salpingectomy, oophorectomy, appendectomy	21	Cured.
B. M.	Double salpingectomy, oophorectomy, appendectomy	18	Cured.
S. B.	Double salpingectomy, oophorectomy, appendectomy	21	Cured.
E. W.	Double salpingectomy, hysterectomy, appendectomy	22	Cured.
F. A.	Double salpingectomy, oophorectomy, appendectomy	27	Cured.
H. D.	Double salpingectomy, hysterectomy, appendectomy	17	Cured.
M. O	Double salpingectomy, hysterectomy, appendectomy	32	Cured.
A. J.	Double salpingectomy, oophorectomy, appendectomy	24	Cured.
D. M.	Double salpingectomy, hysterectomy, appendectomy	26	Cured.
L. M.	Double salpingectomy, hysterectomy, left oophorectomy, appendectomy	21	Cured.
M. F.	Double salpingectomy, oophorectomy, appendectomy	17	Cured.
A. S.	Double salpingectomy, appendectomy	14	Cured.
S. A.	Double salpingectomy, oophorectomy, appendectomy	19	Cured.
C. S.	Double salpingectomy, appendectomy	20	Cured.
L. W.	Double salpingectomy, left oophorectomy	29	Cured.
E. B.	Double salpingectomy, appendectomy	17	Cured.
L. H.	Double salpingectomy, right oophorectomy, appendectomy	32	Cured.
M. M.	Double salpingectomy, left oophorectomy, appendectomy	24	Cured.
I. McW.	Double salpingectomy, right oophorectomy	21	Cured.
M. S.	Double salpingectomy, oophorectomy, appendectomy	18	Cured.
L. C.	Double salpingectomy, left oophorectomy, appendectomy	21	Cured.
E. M.	Double salpingectomy, appendectomy	23	Cured.
G. R.	Double salpingectomy, appendectomy	33	Cured.
M. M.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
C. H.	Double salpingectomy, right oophorectomy, appendectomy	18	Cured.
L. W.	Double salpingectomy, right oophorectomy, hysterectomy, appendectomy	21	Cured.
C. D.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
M. F.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
H. B.	Double salpingectomy, hysterectomy, right oophorectomy, appendectomy	31	Cured.
S. S.	Double salpingectomy, oophorectomy, appendectomy	17	Cured.
A. P.	Double salpingectomy, right oophorectomy, appendectomy	18	Cured.
T. H.	Double salpingectomy, right oophorectomy, appendectomy	23	Cured.
A. C.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.
S. C.	Double salpingectomy, oophorectomy, appendectomy	21	Cured.
W. L.	Left salpingectomy, oophorectomy, appendectomy	21	Cured.
A. W.	Double salpingectomy, hysterectomy, appendectomy	24	Cured.
R. E.	Double salpingectomy, hysterectomy, left oophorectomy, appendectomy	24	Cured.
M. E.	Double salpingectomy, hysterectomy, appendectomy	21	Cured.

The following complete case histories are presented as illustrative of the four different types usually found.

CASE 1. M. G., age 38, single, complained of abdominal pain, nausea and vomiting. The family history was negative. About 9 years ago, patient says that she had an attack similar to this and had a vaginal operation with drainage, and was in the hospital 1 month. Since then she has had three or four similar attacks, although she has gone for a year or longer without one. Her appetite and digestion are poor, she has no nervous symptoms. The

menses have been irregular and nearly always painful. She has had no bladder trouble. She has lost 15 pounds in weight. Two days before admission the patient was seized with abdominal pain, and suffered with fever, nausea and vomiting, was unable to retain nourishment, and was constipated.

Physical examination showed a thin, emaciated, anæmic woman, with pale conjunctivæ, good teeth, slightly enlarged tonsils. Temperature, 101°; pulse, 86; respiration, 24. The neck, chest, and extremities were negative. The abdomen was not distended, was tender over both lower quadrants, and there was definite muscle rigidity. Vaginal examination showed the urethra and cervix normal. The uterus felt normal in size and was slightly movable. A mass about the size of a lemon was felt on the left side, and a mass somewhat smaller on the right side. A vaginal scar is present in the cul-de-sac from the previous colpotomy.

Blood examination showed 8,700 white blood cells; polymorphonuclears, 80 per cent; mononuclears, 20 per cent; negative for malaria. Urine examination showed reaction, acid; specific gravity, 1016; albumin, 1 plus; sugar, negative; microscopic pus, 3. Blood pressure was 115 systolic, 85 diastolic.

The patient was treated expectantly as above described and on the fifth day the temperature reached 103.6°, pulse 124, respiration 29. The urine was negative. The blood examination showed white blood cells, 11,600; polymorphonuclears, 92 per cent; mononuclears, 8; Widal, negative. Blood culture was negative, Wassermann, negative. Patient was operated upon this day. Diagnosis: acute double salpingitis. Gas-ether anæsthesia was used. Hypodermoclysis of glucose and saline was given. A low mid-line incision was used. On opening the abdomen we found a double salpingitis with a large infected left ovary, the size of an orange. The right ovary was also infected and enlarged. The appendix was long and the tip was bound to the right pelvic mass. Both tubes, ovaries, and appendix were removed, and an iodoform gauze and rubber drain inserted. On section both tubes and left ovary were found to be filled with pus. The drain was gradually removed until on the sixteenth day it was completely out, and a tube was inserted for 6 days. The patient was dismissed on the thirty-eighth day, and the wound was completely healed. Convalescence was uninterrupted.

Case 2. Mrs. P., age 38, housewife, complained of pain in stomach, fever and nausea. The family history was negative. Patient has had the usual diseases of childhood. Eight years ago she had an attack similar to the present one and since that she has had several attacks. She has been very nervous and irritable, and has been unable to do ordinary housework on account of weakness. She states that she has had continuous pain in the back. Appetite and digestion are poor, bowels constipated; menses irregular and painful. She has had leucorrhœa for several years. At times there is burning on urination. She has three children, the youngest 9 years old. She has had no miscarriages. She has lost 20 to 25 pounds in weight in last 3 or 4 years.

About 2 days before entering the hospital patient was seized with pain in lower part of abdomen. The pain was very intense and cramp-like. She was nauseated and vomited since onset. The bowels have not moved.

Physical examination showed a thin, emaciated patient, with cheeks flushed, and suffering. Temperature was 102°; pulse, 130, respiration 30. The head, neck, chest, and extremities were negative. The abdomen was distended. Palpation was difficult on account of tenderness and rigidity, which are more marked in lower quadrant. Vaginal examination showed the cervix lacerated, leucorrhœal discharge, urethra normal in appearance, no discharge. On bimanual palpation a definite mass is felt on both sides, movable and apparently bound down. The uterus is retroverted, the cul-de-sac bulging. Diagnosis; acute exacerbation of a chronic pelvic cellulitis.

The patient was operated upon morning after admission. Hypodermoclysis of glucose and saline was started. Gas-ether anæsthesia was used and operation was done through lower mid-line incision. When the abdomen was opened, a quantity of turbid fluid escaped. The intestines and peritoneum were violently red, showing a general peritonitis. The omentum and a loop of intestine were firmly adherent to a pelvic mass. By the technique described above, the omentum and intestines were freed, and the tubes and ovaries brought into the field of operation. The tubes were red, swollen, and contained pus. Total hysterectomy and salpingectomy were done. The right ovary was left. Iodoform gauze and rubber drain inserted, and wound closed. For the first week after operation, drainage was very abundant. The drain loosened on the tenth day and was gradually removed until on the sixteenth day removal was complete. Patient was discharged from hospital on twenty-seventh day. She had gained 12 pounds in weight and felt fine.

Case 3. Mrs. McD., age 22, housewife; complained of pain in abdomen, rigors, fever, vaginal discharge. The family history was negative. Patient had had usual diseases of childhood. She had never been severely sick before present illness. She has one child 2 weeks old, has had no miscarriages. Menses began at 16, normal and regular. Two weeks ago patient was delivered of a normal child by her physician. Three days later she began to have high fever, rigors, pain in abdomen, nausea, and vomiting, with bowels constipated.

Physical examination showed an emaciated, nervous woman, with flushed face; lips dry and cracked; tongue dry; temperature, 105.6°; pulse, 140; respiration, 40. The head, neck, chest, and extremities are negative. The abdomen was scaphoid, not distended, lower quadrant tender, with marked muscle rigidity. No masses were felt. Vaginal examination showed the cervix lacerated, œdematous, red, with mucopurulent discharge. The urethra was normal, uterus enlarged, soft, movable. Large tubes could be palpated. Cystoscopic examination showed a mild cystitis, ureteral orifices normal. Catheterized specimen from each ureter was free from pus.

Blood examination showed white blood cells, 17,400; hæmaglobin, 75 per cent; polymorphonuclears, 88 per cent; mononuclears, 12 per cent; transitionals, 2 per cent. Malaria, negative; Wassermann, negative (subsequent). Urine examination showed reaction, acid, specific gravity, 1020; albumin, sugar, pus. Microscopic examination showed pus cells. Examination of catheterized specimen from ureters showed no albumin, no sugar, and microscopic negative. Blood pressure, systolic 120, diastolic 115. Diagnosis: puerperal infection.

Patient was operated upon day of admission, under gas-oxygen anæsthesia. Hypodermoclysis of glucose and saline started. A lower mid-line incision was made. A small amount of turbid fluid was found, the intestines were packed off, the uterus was found enlarged, red. and soft. Both tubes were swollen and of a firey red color. Both tubes and the uterus were removed by technique described above. Iodoform gauze and rubber glove drain inserted. Three days after operation temperature came down to normal. Patient discharged from hospital on eighteenth day, cured.

Case 4. L. L. M., colored, age 19, single, complained of pain in abdomen and swollen joints. The family history was negative. Patient has always been well until present

illness. Probably was infected 2 months before admission. Patient had had the usual diseases of childhood. She has no indigestion, the bowels are regular, she has no sore throat or tonsillitis. Menses began at 15, and have been regular. Urination has been painful for past 2 months. The day before admission to hospital, pain began in lower part of abdomen, was somewhat more severe in right side than left. She did not vomit although she was nauseated. Urination was frequent and painful. The night before admission the fingers and left wrist became swollen and painful.

Physical examination showed a well-nourished negro girl, suffering. The tongue was coated, the teeth good, the tonsils normal, the pharnyx normal. Temperature, 102°, pulse, 100; respiration, 24. The neck shows no glandular enlargement. The heart and lungs are negative. The abdomen is slightly distended, and there is extreme tenderness throughout the entire lower portion, with marked muscle rigidity. No masses are felt. The left wrist and joints of first two fingers of left hand are swollen, hot, and tender. Vaginal examination shows the cervix red. Bartholin's glands are palpable. The mouth of the urethra is red and swollen. A definite mass is felt on each side of the uterus which is bound down and adherent. The cul-de-sac is slightly bulging.

Examination of the blood shows white blood cells 10,800; red blood cells, 4,800,000; polymorphonuclears, 82 per cent; mononuclears, 16 per cent; transitionals, 2 per cent; Wassermann, negative. Urine examination shows reaction, acid; specific gravity 1016; albumin, none; sugar, none; and microscopic examination shows pus cells. Smear from the urethra shows gram positive and negative diplococci. Diagnosis: gonorrhœal salpingitis and arthritis.

The patient was operated upon the day after admission. Ether anæsthesia was used. Hypodermoclysis of saline was started as soon as patient was anæsthetized. A midline incision was made and the omentum was found to be bound down to pelvic organs. By the technique described the tubes were delivered into the field of operation. The tubes were red, swollen, and covered with flakes of fibrin. The left ovary was enlarged, and of a purplish, grayish color. Both tubes and left ovary were removed. The appendix was removed also. Iodoform gauze overlaid with rubber dam was used as drains and the wound closed. On the fourth day after operation the swelling in the wrist and fingers disappeared. The drain was removed on the eighth day. Patient dismissed on seventeenth day, with wound completely healed and free from symptoms.

AXIOMATIC REVIEW IN PARALLEL

CONSERVATIVE	RADICAL
"Fresh inflammatory conditions are a *noli tangere* for operative interference."	"In 1885 Lawson Tait had gained the reputation of curing suppurative peritonitis by laparotomy, extending his fame throughout England and the continent of Europe; he gained this by radical excision."
"The treatment of all puerperal infections should be entirely medical, as surgical procedures are more injurious than helpful. The treatment of non-puerperal pelvic infections in the acute period is also chiefly medical."	"In acute cases defer operation sufficiently long for the individual to develop immunity, while in subacute and in the acute recurrent cases immediate operation is the safe and wise procedure."
"Treatment: Absolute rest. Purgatives. Application of ice or heat and light. Restriction of diet, unless it is evident that free effusion has taken place in the peritoneal cavity, or that pus sacs are in Douglas pouch when either colpotomy or laparotomy is advised."	"As the surgeon treating war wounds found excision of necrotic and infected tissues (*débridement*) lessened mortality and morbidity, and was the surest way to obtain primary union, so also the abdominal surgeon removed the focus of infection as the primary and fundamental basis of surgical treatment."
"Many patients with acute salpingitis recover and remain permanently well without surgical intervention."	"When the tubes and ovaries are infected, the proper procedure is to remove them entirely."
"Opening the abscess by the vagina, even in acute stages often saves life and results in permanent cure."	"Gonococcic peritonitis is a perforative peritonitis from rupture of pyosalpinx or an ovarian abscess."
"In from 9 to 12 months a closed pyosalpinx will have become sterile."	"In the virulent infections of the streptococcal type it may be one of the most dangerous conditions that can confront the surgeon, when associated with disease of the ovaries and extensive suppuration of the tube, the possibility of cure in the sense of restoration of function is impossible."
"The gonococcus rarely causes peritonitis."	"If the salpingitis is of gonococcal origin, the hope of future pregnancy is practically nil, and the operation should be as extensive as conditions require."
"In those pyogenic infections exclusive of the gonococcal type, in time the organism has run its course and is generally dead; not so, however, with the gonococcus, which may remain latent indefinitely."	"The majority of gonococcal pus tubes removed are quiescent and the organism responsible for the infection has long since died."
"If patients do not die from general peritonitis, it is because the pus is walled in by adhesions and its spread limited."	"When a pus pocket forms it may erode into bowel and discharge its contents. Such a sac is never completely emptied If partly empties itself and then primarily closes and the reaccumulation reopens it. Such a course may continue for a period of years, or until the strength of the patient is exhausted."
"The separation of adhesions is quite easily accomplished in acute cases, but we seldom operate on the acute cases, so that by the time the surgeon encounters these adhesions they are firm and dangerous to deal with."	"Severe menorrhagia and leucorrhœa persist after bilateral salpingectomy."
"The more I operate, the less I drain. Drains may even embarrass the peritoneum, diminishing its resistance. In the very weak it is better to drain and not depend too much on the peritoneum's resistance to infection, but	"In sexually mature women, hystero-salpingo-oophorectomy is followed by a lower mortality, and a greater certainty of restoration than is possible after conservative operations."
	"The after-care of salpingitis patients is mea-

to drain, for many women have died a week after pelvic operations from a spreading peritonitis, who would have been saved by drainage at the time of operation."

"Gauze packing in the peritoneal cavity has no place in modern surgery."

sured by the life of the individual, unless all organs which are the various habitats of the gonococcus are removed; these are the uterus, tubes, Skene's and Bartholin's Glands."

"The least rapid convalescence seems to follow the conservative operation while the most rapid is after hysterectomies."

STATISTICS COLLECTED FROM LITERATURE

Of 91 cases reported of rupture of pyosalpinx as a cause of diffuse peritonitis 54 died; 36 were not operated upon and all died, a mortality of 100 per cent. Of 55 cases operated upon, 18 died. Of 19 cases operated on in 12 hours 2 died. Brickner: Surg., Gynec., & Obst. 1912 May.)

Fourteen per cent with closed abdominal incision suppurated when the pelvic drain was brought through the cul-de-sac into vagina. No suppuration of wound occurred when drain was brought out through abdominal incision. In 145 cases of resection of tubes 50 obtained symptomatic cure, three became pregnant. (Ballard: Am. J. Obst., 1919, May.)

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THE TREATMENT OF GONORRHŒA IN THE LOWER GENITO-URINARY TRACT IN WOMEN

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GONORRHŒA in women may be regarded as a two-stage disease. In the first stage the disease is limited to the cervix and lower genital tract; in the second stage the infection has spread upward and involved the corporeal endometrium, tubes, ovaries, and pelvic peritoneum. These two stages are quite distinct clinically. In the first stage the symptoms are comparatively mild, and unless a suburethral or a Bartholinian abscess develops, there is comparatively little pain; in the second stage, however, there are well-marked symptoms, the condition, for want of a better term, often being spoken of as pelvic inflammatory disease, although the latter may be the result of micro-organisms other than gonococci.

In the first stage, except during the acute period, a positive diagnosis is frequently made only with difficulty, even by the specialist. The discharge is often scanty, and gonococci are usually demonstrated with difficulty, and only after repeated examinations. In many of the cases in this stage the diagnosis is not made, and not a few never apply for treatment unless intraperitoneal lesions have developed. As a rule, the treatment generally extended to patients in the first stage of the disease is less effective than that given to any other class of patients. An occasional local treatment and the employment of a vaginal douche, often without adequate instructions as to how the latter is to be administered, constitutes practically all the treatment many of these patients receive. A douche is of value for its cleansing effect, and perhaps in a slight degree because of the bactericidal properties of its constituents; unless, however, it is supplemented by other measures, it is useless so far as its curative properties are concerned.

The statement has often been made that the average obstetric case receives less efficient medical care than does any other class of patients—a statement that is even more applicable to the woman suffering from gonorrhœa of the lower genital tract. There are many reasons for this: The disease is essentially chronic, and yields slowly to treatment; the patients do not suffer acutely, and are, indeed, often almost free from symptoms, so that it is frequently difficult to get them to persist in the treatment until a cure has been effected. This, coupled with the fact that it may be inadvisable to acquaint the patient with the nature of her disease, renders the treatment doubly difficult. This is particularly the case with dispensary patients. Many cases suffer frequent reinfection, and in these patients treatment is without avail unless they can be induced to change their mode of living.

The necessity for treatment during the first stage of the disease is obvious, since the danger of extension of the infection upward, with the development of serious complications that often require mutilating operations for relief, is too well recognized to require comment. The necessity for observing prophylaxis, both of the patient and of those with whom she is brought into contact, is also of the utmost importance.

In men the early stage of the disease is usually well-marked and painful, and the patients therefore seek treatment early; in the terminal stages the symptoms are often mild or almost absent, and it is then that the man is especially prone to spread the gonorrhœal infection. Such patients, while aware that they have had the disease, often believe themselves cured. The woman, on the other hand, is likely to be a disseminator of infection during the first stage of the disease, at which time her symptoms are mild and she may not even be aware that she is an incumbent of gonorrhœa.

The gonococcus is in many respects a remarkable organism and possesses peculiar properties. It is easily killed by heat or cold. Its growth is inhibited or it is killed more or less rapidly by room temperature. Desiccation destroys the gonococcus. It is grown only with difficulty in artificial media; it requires a special medium and will not grow in most of the ordinary culture-media. The medium must possess the proper reaction. The micro-organism must be grown at a certain definite temperature, slight departures from which will inhibit its growth. To obtain the best results the medium must be inoculated directly, to prevent the suspected material from becoming chilled. In artificial media the gonococcus produces at best but a scanty growth, and must frequently be subcultured. It is easily crowded out by other more rapidly growing micro-organisms. It is readily killed by extremely weak dilutions of any of the ordinary antiseptics. Nevertheless, despite these peculiarities, the

organism, when in the female genital tract, exhibits a marked chronicity and a resistance to treatment that are perhaps its chief characteristics. The student may well ask himself the reason for these apparently divergent properties of the gonococcus. The first explanation that is likely to be made is that the gonococcus possesses more marked vitality in man than when grown in artificial media, and this assumption may be somewhat strengthened by the fact that the organism is pathogenic only to man. The correctness of this explanation is, at least, doubtful. A more probable theory would be that our treatment does not reach the micro-organisms and the organisms have extended to the deeper tissues, as they have done in practically every case that applies for treatment.

Luys[1] states that surface gonorrhœa is cured with ease, but that the disease is continued by reinfection of micro-organisms from the deeper layer of the tissue. The experiments of Derby[2] and others have shown that the local action of silver nitrate, corrosive sublimate, and certain other gonococcids is retarded greatly by the addition of serum. All gonococcids lose their efficiency more or less in the presence of mucus. It is probable that the chronicity of gonorrhœa in the female and its resistance to treatment are not due to any marked vitality of the organism and unusual resistance to the ordinary gonococcids, but to the fact that, during the customary treatment, the bactericid does not reach the deeper situated gonococci, which are constantly producing reinfection from below. This theory is greatly strengthened when we consider the efficacy of the Credé prophylactic treatment for ophthalmia neonatorum. In this condition the gonococci are virulent organisms. The susceptibility of the conjunctiva to this form of infection is well known, yet one drop of a 1 per cent silver nitrate solution instilled in the eye will, with the greatest regularity, destroy the organisms and prevent the development of conjunctivitis. The efficiency of prophylactic treatment for venereal disease as employed with our military forces during the recent war is further proof of this fact. It has been shown that, beyond doubt, if the prophylactic treatment is properly applied within a certain definite time limit after exposure gonorrhœa will very rarely result. In these instances the gonococci are virulent and are implanted upon soil favorable for their development. As long as the micro-organisms are limited to the surface and the gonococcid, not too diluted, can be brought into contact with them, so long can the development of the disease be inhibited. If the prophylactic treatment is applied after the micro-organisms have had time to reach the deeper tissues. the treatment is futile. In an effort to apply this theory to the treatment of gonorrhœa of the lower genital tract of the female the following plan has been evolved. The poor results of the treatment as often applied are probably due to the structural peculiarities of the female genital tract, which prevent the gonococcid from reaching the organisms in the depths of the tissue.

The three areas in which the gonococcus lodges and from which it is most difficult to eradicate the infection are the cervical glands, Skene's tubules in the urethra. and Bartholin's glands. All these areas contain more or less deep, tortuous, and mucus-bearing glands. In view of the necessity of eradicating the disease, it would seem rational therefore, as a preliminary measure, to attempt to destroy, as far as possible, the harboring places of the gonococci.

Bartholin's gland. Bartholin's gland is situated in the lower and posterior portion of the labia majora, partly under the bulbocavernosus (sphincter vaginæ) muscle. In some subjects it is entirely covered by the muscle, whereas in others it is partly embedded in the spongy tissue of the bulb. The gland extends posteriorly to the triangular ligament. Normally, it is about the size of a small bean, but it varies quite markedly, even in health, and according to the age of the patient. Atrophy of the gland occurs at the menopause. The duct is about 1.5 centimeters in length and 1.5 to 3 millimeters in diameter. It runs upward and inward. A differentiation between infection of the duct and that of the gland should be made. Every case in which a gonococcal macula is present does not suffer from a gland infection. If the gland is enlarged, swollen, or tender it should be excised. In this connection it should be remembered that the normal gland cannot, as a rule, be palpated except occasionally in thin subjects. In some long-standing cases the gland is firm and sclerotic—the so-called "adenitis glandulæ Bartholinæ scleroticans" of Saenger. More often it is somewhat swollen and tender, and occasionally suppuration takes place. The statement has been made that a Bartholinian abscess does not form except in the presence of a mixed infection. Whether or not a mixed infection is present is of no great moment, so far as the treatment is concerned. In any event, if the gland is infected, the surest and quickest treatment consists of excision. Infection of the duct yields quite readily to injections.

[1]Luys, G. Traité de blennorragie et de ses complications. Paris. 1912.
[2]Derby, G. S. Boston M. & S. J. 1906, September 27.

In those cases in which this treatment is not effective it is likely that the gland is involved, and in such patients excision of the gland is advisable. This surgical procedure may be facilitated by making a preliminary forcible injection of methylene-blue solution. In some cases, especially the sclerotic variety of bartholinitis, the staining fluid will often not reach the entire gland, but even then the blue-stained tissue is a useful guide in performing the excision. If the gland is excised care should be taken to remove the entire structure and duct, thus eliminating one of the three chief harboring-places for the gonococcus. Stevens and Heppner [1] have recently urged the excision of infected Bartholinian glands.

Urethritis, in contradistinction to skenitis, is a transient disease, and generally clears up in a week or thereabouts whether or not treatment is instituted. In infection of Skene's tubules, however, the condition persists for prolonged periods. Skene's tubules are usually two in number and about 1 centimeter in length; they lie in the floor of the urethra and run parallel to it, their openings being situated in the urethral floor, just within the external urinary meatus. The destruction of those tubules is a simple procedure, and may be accomplished either with a cautery needle or by splitting them up through an operating urethroscope. The fact that a third or a fourth gland may be present should be borne in mind. Schueller [2] has especially directed attention to these supernumerary glands. By splitting up the glands in the floor of the urethra this structure is converted into a fairly straight tube, to which gonococcids can subsequently be applied effectually.

Cervix. In dealing with gonorrhœa of the cervix, a more difficult problem is encountered. The cervical glands are deep, branched, filled with mucus, and penetrate for some distance into the myometrium. In addition to this the arbor vitæ are pronounced, and when infection is present, these ridges are swollen, so that the cervical canal contains many crypts and folds, all of which are filled with thick tenacious mucus. Trachelectomy (Sturmdorf operation) may be the logical procedure, but the difficulty of excising all the infected mucosa, the danger of spreading the infection upward or of destroying the barrier formed by the internal os, and perhaps the slightly increased danger of the operation, should influence the surgeon against adopting this form of treatment except in very stubborn cases. The fact that many of the patients are young women and may subsequently become pregnant, and that under such circumstances dystocia may result from operation should also be borne in mind. A better method consists in thorough dilatation of the lower portion of the cervical canal and the application of a gonococcid. Findley [3] has suggested this treatment, and finds that by its use the duration of the cervical infection can be greatly reduced. It may subsequently be found necessary to repeat the dilatation a few times. Care must be exercised not to dilate the internal os; if this should accidentally be done, the uterine cavity should be swabbed with an efficient gonococcid. A little care will, however, prevent this accident. A solid dilator is a convenient instrument with which to perform the dilatation. A shoulder may be fitted on it, to prevent too deep penetration. The performance of trachelectomy should be reserved for those cases that do not yield to other means. If either of Bartholin's glands are infected, a good plan is to administer nitrous oxid and perform all the operations at a single sitting. If it is subsequently found that one of the glands in the floor of the urethra has been overlooked, this may be slit up under local anæsthesia. It will usually be found necessary to dilate the cervix more than once, but if the first dilatation has been a thorough one, subsequent dilatation can generally be performed under local anæsthesia. The method just described permits the operator to apply treatment to the depths of the diseased tissues, and should be considered as a preliminary to efficient treatment. In itself it is not curative, except in so far as Bartholin's gland is concerned, when the latter is excised.

The choice of the gonococcid is important. Although the gonococcus is relatively easily destroyed by most antiseptics, some possess greater gonococcidal properties than others, and some penetrate more deeply and are less likely to undergo chemical change in the presence of mucus than are others. Mercurochrome, mercurophen, and Dakin's solution are all satisfactory gonococcids. An oily or sticky solution is the most preferable one to use. Dakin's solution in 1,2, or 5 per cent strength, made up with olive oil, is extremely efficacious. Of far greater importance than the choice of a gonococcid are the thoroughness and regularity with which the treatment is carried out. This is particularly true of the treatment of the cervix, where the preliminary cleansing and removal of the mucus prior to the application of the gonococcid are of the utmost importance. It should be remembered, for example, that if the disease in the urethra is cured and the in-

[1] Stevens, W. E., and Heppner, M. J. Am. M. Ass., 1920, lxxv, 1477.
[2] Schueller. Festschr. f. Bernard Schultze, Berlin, 1883, iv, 16.
[3] Findley, P. Am. J. Obst., 1919, lxxx, 321.

fected cervix is neglected, the former structure will in a short time probably become reinfected. For this reason the treatment should be so intensive as to eradicate the infection from all adjacent areas. A point that, in my opinion, is often overlooked is that it is useless to attempt treatment in a woman who is being frequently reinfected. Therefore, in married patients, the necessity of securing treatment for the husband is apparent. The employment of methylene-blue, or the incorporation of this or of some other staining material in the medication which the patient is to apply herself, has been advocated. In itself methylene-blue is a more or less efficient gonococcid, although it is probably inferior to certain others. The plan is, however, a useful one, since the operator can determine by the amount of stain whether or not the patient has been regular in her treatments. In loose women the staining of the vulva may also act beneficially in preventing coitus. The employment of methylene-blue, or the incorporation of this substance with other gonococcids, is of greater value in the treatment of dispensary than of private patients. During the menstrual period especial effort should be made to prevent the upward extension of the infection. With this end in view all local treatment should be suspended at the menstrual epoch, and the patient should be kept in bed in the Fower position, or at least confined to her room. The administration of small doses of atropin has been advised.[1] Watson[2] believes that coitus is a potent factor in the upward extension of the infection. It is a significant fact that in Findley's[3] series of cases, which was composed of loose women, he remarks upon the infrequency of pelvic inflammatory disease. However, apart from the question of the rôle played by coitus in the upward spread of the infection, for prophylactic reasons, and to prevent reinfection, continence should be practiced. The only danger from this treatment is that the dilatation of the cervix may result in the upward spread of the infection. In the hands of a careful surgeon this risk is slight. The author has employed this treatment in 17 cases with good results. This form of treatment materially shortens the duration of the disease. This fact should be borne in mind because the longer the infection is present in the lower genital tract the greater is the likelihood of an upward spread of the disease.

The above treatment is not recommended as a routine method for all cases. It is, however, advisable in those cases which have proved intractable to less radical procedures.

[1] Norris, Charles C. Gonorrhœa in Women. Philadelphia and London: 1913, p. 230.

[2] Watson, D. Gonorrhœa and its Complications. New York: 1915.

[3] Findley, P. Ibid.

EDITORIAL

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. .....Managing Editor
ALLEN B. KANAVEL, M.D. .....Associate Editor

SEPTEMBER, 1921

STANDARDIZATION OF HOSPITAL STATISTICS

Sir Berkeley Moynihan has remarked: "Statistics can be made to tell anything, even the truth." Buckle, in his *History of the Civilization of England*, profoundly influenced the thought of his time by his masterly use of statistics. He arrayed known but little appreciated facts in such manner that they became mountain peaks on the skyline of knowledge and gave perspectives which were as fascinating in their greatness as the materials of which they were made were common and sordid. Buckle showed that given a large city, such as Paris, where reasonable statistics are available, happenings ordinarily supposed to be accidental may be foretold a year in advance; for example, the number of legs broken, and which leg, and the number of suicides. He also showed the relation of the cheapness of food to marriage and fecundity and that the theological modifications of the Christian religion are due primarily to environment. Buckle died at the age of 41, after publishing the two introductory volumes of his work. In our day, however, even statistics are influenced by the exaltation of the minute and the exaggeration of details which produce, not mountain peaks on the skyline, but ant hills under foot, and for perspective, ash cans at the back door filled with statistical rubbish.

Great credit is due to Codman for his unselfish labor in collecting valuable data with regard to the results of operations for sarcoma of the bone. The Scandinavian countries are collaborating in collecting statistical reports of great magnitude, and are using the journal of their organization for the publication of results.

At a meeting of the Board of Regents of the American College of Surgeons held in Boston recently, it was decided to make available the statistics of the wealth of pathological material in the hospitals of this country. Such statistics, properly compiled, would illuminate many dark pages in our book of knowledge. The value of mass research in this field lies not only in the discovery of an occasional new peak on the pathological skyline, but also in giving body to current opinions not as yet accepted for want of basis in pathological fact. The great success of the American College of Surgeons in its campaign for the standardization of hospitals has been owing to the fact that the work has been confined to a few vital problems. Had it been complicated by many problems it would have failed in its purpose.

To the inexperienced it may appear to be a simple matter to secure comparable data, for instance with regard to the operative mortality of different hospitals, but this is by no means the fact. The personal equation of the surgeon, his skill and experience, and his pride in his statistics, may control the results to a marked extent. At the present time each

surgeon has his own method of estimating mortality and with some care in window dressing, groups of statistics which are justly comparable can be made to show remarkable but misleading differences in percentages. In estimating mortality, it should be clearly stated whether the percentages are based on the number of operations or the number of patients. A number of small operations may be performed on a patient, and if he dies the death rate apparently is reduced, although he is just as dead as though he had died from the first operation. Difficulties are encountered, too, if such patients leave the hospital after the first operation, and die outside the hospital before the later stages of the operation can be performed, although a complete one-stage operation might have been done, thus making it very difficult to obtain comparable statistics. This is particularly true of cases of malignant disease in which the type of cases chosen for operation controls the mortality, and operability is the chief consideration. We must not forget, however, that the death of the patient defeats the purpose of the operation, and methods that will reduce the death rate to the smallest possible extent are essential. The American College of Surgeons has undertaken a great task of collective investigation, the details of which must be carefully worked out.

WILLIAM J. MAYO.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD APRIL 1, 1921, DR. WILLIAM FULLER, PRESIDING

DR. DAVID J. DAVIS read a paper on "The Distribution of Hæmolytic Streptococci in the Body."

DR. GATEWOOD read a paper on "Cholecystenterostomy from an Experimental Standpoint."

FRACTURE OF THE TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRÆ

DR. GEORGE G. DAVIS read a paper on "Fracture of the Transverse Processes of the Lumbar Vertebræ." (See p. 272)

DISCUSSION

DR. C. C. ROGERS: I was much pleased to hear the paper of Dr. Davis although the symptoms in some of the cases I have had do not tally with those described by Dr. Davis. I looked over some of my cases today, and I have a report of 7 cases that are interesting from the standpoint of fracture of the transverse processes of the lumbar vertebræ.

The first of these was a girl who fell from a horse in Denver in 1906. She was taken to a hospital, and although, as Dr. Davis says, the pain in his cases was produced in the back, this girl had no pain in the back, all the pain was in the right knee. She went about on crutches for 14 months without any relief from the pain in her knee. The transverse processes of the third and fourth vertebræ were removed in 1907. The girl improved and made an uninterrupted recovery. She was a show girl, dancing on the stage, and inside of 6 months she was back dancing, and as far as I know she is still following that occupation. I have not heard from her for 3 or 4 years.

The second case I had in 1910 was that of a girl who was injured in an accident on 13th Street of this city. She was taken to the County Hospital, and her pain was all in the knee. A cast was applied to the knee and allowed to remain on for 3 weeks. When the cast was taken off she had as much pain as she had before. She was sent home. She came back to the hospital again in 1910, and X-ray examination showed fracture of the third and fourth lumbar vertebræ on either the right or the left side, I don't remember which now. These processes were removed and the girl made an uninterrupted recovery.

I have had four cases where there was no pain whatever in the back so far as symptoms were concerned. All four of these cases had this symptom. when they were lying on the back they could flex the leg upon the thigh and the thigh upon the abdomen, but they could not extend the leg. They walked with canes or crutches and got well after the operation.

Another patient was going down stairs, stubbed her toe, fell three steps, was picked up, and taken home. Her pain was referred to the back. She went on for weeks and finally had the processes which were fractured removed and she got well.

A Mr. B. fell out of a cherry tree 5 years ago and fractured the transverse processes. His pain was referred to the back. Of the seven cases I looked up the pain was referred to the knee on the corresponding side in four cases. In three of them the pain was referred to the back.

In one of the seven cases the injury was produced by a wagon tongue striking patient in the lumbar region. First the patient had the appendix removed. This gave no relief of the symptoms. Later the kidney was explored with negative findings for stone. After being unable to work for 1 year the fractured transverse processes were removed and the pain was completely relieved.

Five of the seven cases were females, two males.

I mention these cases because a year or two ago a paper was read before this society on pain in the knee and at that time I asked whether any pictures had been taken of the back and I was told emphatically there was no reason for taking a picture of the back, and I sat down.

DR. B. F. LOUNSBURY: I have been very much interested in Dr. Davis' paper. In our work we have a large number of traumatic cases. Large corporations have been in the habit of looking skeptically on any man who complains of pain for a long time without demonstrable lesion and we have found it necessary to differentiate between a sprain of the back and some graver condition. I know in the past a great many cases have been considered malingerers who have been suffering from a serious lesion. Since our X-ray technique has been improved sufficiently to get a good roentgenogram of the spine, it has not been uncommon to pick up one of these fractures of the transverse processes.

Recently we had a case of fracture of the pelvis which was complicated by a fracture of all of the transverse lumbar processes on one side, and three on the opposite side. These cases have happened

in working men with good heavy musculature. At first I thought them due to direct violence, but I can see from what Dr. Davis has said that muscular strain is the etiological factor. The disability varies. I have not removed any of the transverse processes of the vertebræ, and ultimately all the men have returned to work.

DR. D. B. PHEMISTER: I would like to ask Dr. Davis if he has found in consulting the literature that pseudo-arthritis is frequently associated with this condition. I have seen it, as shown in the slides, in two instances. In one case the injury extended to the lower lumbar vertebra. It struck me as a coincidence that one should see it in three instances. Probably traumatism has something to do with its development.

DR. ROGER T. VAUGHAN: In the differential diagnosis of these fractures of the transverse processes I have seen a condition referred to as "pseudo-fracture" of the transverse process. It is not always easy to differentiate these "pseudo-fractures" from genuine fractures and diagnostic errors are not infrequently made by surgeons who are not thoroughly familiar with the normal anatomic variations in this region as revealed by the X-ray.

It is important to remember that the transverse processes may lie horizontally or may lie obliquely either upward or downward, and one transverse process may extend out horizontally and the process on the other side of the same vertebra may lie obliquely upward or downward as in one of the cases which Dr. Davis has just shown us on the screen.

Not infrequently the terminal portion of the process, which arises from a separate center of ossification, as you know, is considerably denser than the proximal portion. Consequently one may definitely visualize the lateral portion of the process lying at a marked angle to the horizontal as compared with its opposite fellow, and so be misled to diagnose as lines of fracture certain muscle outlines, bowel contours or other soft part markings which cross the pedicle of the transverse process more or less transversely or obliquely. Even with stereoscopic duplitized films double screened and with the Potter-Bucky diaphragm, it is not always easy to secure clear visualization of all details of the transverse processes in fat or heavily muscled patients.

DR. HARRY E. MOCK: Dr. Phemister touched on an important point. I recall one case of fracture of the transverse process which, after rest in bed, healed, but pain continued, and an X-ray picture showed osteo-arthritis with some of the vertebræ higher up also involved.

A point of medico-legal importance is whether the osteo-arthritis existed prior to the injury, and caused the pain after the fracture had healed. I would like to know if these pictures showed that osteo-arthritis had developed since the fracture. In other words, were there lipping and other arthritic changes present when the first X-ray, shortly after the fracture occurred, was made?

DR. GATEWOOD: I have seen two instances in miners of the same type of fracture of the transverse processes of the lumbar vertebræ from indirect violence, from blows on the head, the shoulder, or upper part of the back. In at least one instance, and I am not sure about the other, there was osteo-arthritis. It is of common occurrence among the older miners. The idea occurred to me that the reason for the fracture was that in an osteo-arthritic condition fractures more readily occur.

DR. DAVIS (closing): I was very much interested in Dr. Rogers' remarks about the pain being in the region of the knee. In one case I had a patient complain of pain along the leg; that patient also had a fracture of the ilium, and I figured that the patient had, in addition to fracture of the transverse processes, enough pathology to account for the pain in the region of his knee. But I did not see it in any other case.

In answering Dr. Phemister's question, I would state that I have not seen anything in the literature concerning the association of a fracture of the transverse process and osteo-arthritis of the spine, nor of osteo-arthritis as a factor in the etiology of fracture of the transverse process, but vertebræ manifesting these signs of osteo-arthritis may be in such a condition as to predispose the person to fracture.

Dr. Vaughan has called attention to errors in diagnosis in the condition he terms "pseudo-fractures of the transverse process." Another possible error in diagnosing these conditions is found in the first lumbar vertebra. It is possible in a poor picture to misinterpret the relationship of the shadow of the lateral portion of the quadratus lumborum as it passes over the first transverse process for a fracture of the same.

Dr. Mock has called attention to the importance of the medico-legal aspect of the associated findings of osteo-arthritis and fracture of the transverse process. It would, indeed, be difficult to state accurately to what extent pain on bending is due to the fracture of the transverse process and how much is due to osteo-arthritis, and it is quite possible that many cases complaining of pain for a long time following the transverse process fracture may be in reality due to osteo-arthritis.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 4, 1921, DR. WILLIAM FULLER PRESIDING

OSTEOMYELITIS OF THE FOREARM; NERVE SUTURE

Dr. FREDERICK G. DYAS reported two cases and exhibited the patients.

The first case I show you is one of osteomyelitis of the forearm, the musculospiral nerve having been injured at the operation. Patient had the classic wrist-drop, and the nerve was accordingly sutured with catgut, care being taken not to put too much tension on the severed ends, and, at the same time, to prevent, if possible, any muscle or fascia falling in between the severed ends. The arm was put up in a cock-up splint immediately in order to prevent elongation of the extensor tendons, and the wound has practically healed now. There is a little bleeding from the granulations. The operation was done in October. At this time, February 4, there is complete restoration of function.

Sometimes we get an idea that the length of time for regeneration and restoration of function is really longer than it actually is. I think the length of time that the nerve is allowed to go before suture makes a great difference in the time of restoration of function. In this case suture was done immediately.

INJURY TO THE ANTERIOR TIBIAL NERVE AND TENDON

The other case of nerve suture was for an injury to the anterior tibial nerve and tendon. This young man was riding a motor cycle and fell off. The flange of the wheel cut in at the situation where you can see the scar, and immediately he had foot-drop. The nerve was sutured 24 hours later, and at the time of operation an electric excitor was used to be sure that in the wound secretions and blood we were getting the correct tissues together. It was very easy to get a reaction by applying the electrode to the distal segment of the nerve. The tendon was sutured at the same time. The sutures were put in such a way as to take in the neurilemma, doing as little damage as possible to the substance of the nerve. His foot was kept in dorsal flexion by a wire spring splint. He was allowed to go around with this sort of arrangement, which is merely a piece of wire bent to keep pressure upward upon the sole of the foot. It is very light and almost inconspicuous, so that he was given no trouble from heavy braces or a cast, or anything of that sort. He has received some massage and electrical treatment. He has complete restoration of function. The operation was done the first day of July last, and he is able to dance and to do almost everything.

These cases are unusually interesting showing the time of restoration of function when suture of the nerve has not been delayed following the severance of the nerve.

DR. WILLIAM HESSERT described a case of enormous diverticulum of the duodenum.

Dr. HARRY MOCK read a paper entitled "Reconstructive Surgery and the Economic End-Results. Illustrated by a Case of Congenital Absence of Arms."

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

THIS volume[1] is evidence of most meritorious enterprise on the part of an American publisher. The father of medicine has never before been authoritatively presented to an American audience by an American publisher. This fact may in part account for the fact that to most of us, the name Hippocrates represents rather a hallowed shibboleth, a more or less shadily mythical tradition, rather than a vital living force.

As soon as the summer dog days are over and the lure of books returns with longer cooler evenings, every medical man who possesses or aspires to possess medical culture, should secure this estimable volume for the spare hours' collection on his reading table.

The preliminary discourse will give him a pen picture, in short compass, of early Greek medicine, that is admirably stimulating. It may even lead to deeper delving into Baas, or Haeser, or Pagel. If the reader belongs to the group of ultramoderns, he will experience the joy of blunting the conceit of his modernity.

The body of the book is devoted to a translation of Hippocrates' works: On Ancient Medicine, On Airs Waters and Places, On the Prognostics, On Regimen in Acute Diseases, On Epidemics, and On Injuries of the Head. Each one of these works is translated into flawless English and is preceded by a so-called argument, in which the reader is furnished valuable and interesting historical and critical data, largely explanatory in nature.

The second half of the book (vol. 2) follows the same general plan and is devoted to the books: On Fractures, On the Articulations, Mochlcus, Aphorisms, On Ulcers, On Fistulæ, On Hæmorrhoids and On the Sacred Disease (Epilepsy was so called in Early Times).

This is not an appropriate place to examine critically either Hippocratic doctrines or the various commentaries thereon. Adams handles very fully both of these important phases. But this decidedly is the place to emphasize the significance of this book to every practitioner of medicine.

M. G. SEELIG, M.D.

PROSTATIC surgery, probably the most spectacular surgery that is done at the present day, is again called to our attention by the new edition at Freyer's[2] hands. This father and master of prostatic surgery is surely in position to put pap into the mouth of the suckling infant surgeon, so far as surgery of the prostate is concerned.

This little volume consists of a series of lectures on prostatic surgery, dealing almost entirely with prostatic hypertrophy or enlargement as the author chooses to term it. Each lecture is amply illustrated by case history and photographs and drawings of the prostate in question.

It might be stated that the author in his lectures does not devote as much attention to kidney function and the method of its estimation as might be desirable; nevertheless his results indicate that unusual judgment has been exercised as to the time of operation and pre-operative treatment, no doubt with this constant element of danger in mind. Another factor —speed—is constantly dwelt upon. No doubt in a serious case, in spite of high toxicity an eight to fifteen minute anæsthesia with a complete prostatectomy does not jeopardize the life of the patient more than the casual cystostomy by the unskilled operator.

Any surgeon doing prostatic surgery should read this little volume as it has much in store for him.

J. A. WOLFER, M.D.

THE *Collected Papers of the Mayo Clinic* for 1919[3] are at hand. It is always with the greatest pleasure this volume is reviewed, as it constantly affords even the regular reader of the surgical periodicals an agreeable surprise. This volume is of exceptional interest, as it covers a wide field of work. For the ultra-scientist those papers by Kendall on the chemistry of thyroxin, studies on cholesterol by Luden, and studies on influenza-pneumonia by Rosenow are of exceptional value. The average surgeon as well as the internist and general practitioner finds an enormous amount of material on many topics that are of interest. The commonplace subjects are not neglected, and one finds a number of articles dealing with unusual conditions. The great satisfaction in reading these papers is that each is prepared in such a thorough manner and elaborated by extensive laboratory and

[1] THE GENUINE WORKS OF HIPPOCRATES TRANSLATED FROM THE GREEK WITH A PRELIMINARY DISCOURSE AND ANNOTATIONS. By Francis Adams, LL.D., Surgeon. Two Volumes in One. New York: William Wood and Company, 1921.

[2] CLINICAL LECTURES ON ENLARGEMENT OF THE PROSTATE; WITH A DESCRIPTION OF THE AUTHOR'S OPERATION OF TOTAL ENUCLEATION OF THE ORGAN. By Sir Peter J. Freyer, K.C.B., M.D., M.Ch., M.A., LL.D. (Honoris Causa), Nat. U. I. 5th ed. New York: William Wood & Co., 1920.

[3] COLLECTED PAPERS OF THE MAYO CLINIC, Rochester, Minnesota. Vol. xi, 1919. Edited by Mrs. M. H. Mellish. Philadelphia and London: W. B. Saunders Co., 1920.

clinical data that can come only from such a clinic as the Mayo clinic where nothing is taken for granted and where there is a wealth of material as well as a wealth of enthusiasm and facilities to carry on extensive experimental and laboratory work.

It is interesting to note that the present volume is a compilation of the papers of fifty-four individuals, the work of one year; surely an enormous contribution to medical literature and especially so since each paper is a definite contribution to our medical literature. Those papers written by William J. Mayo and Charles H. Mayo are of exceptional interest as they incorporate the mellow and mature thought of men ripe in experience who can see far into the future. These men are to medicine today what the prophets of old were to their peoples. One can truthfully say there is no single volume of medical literature today which affords the reader more real pleasure and profit, and more diversity of material that pertains to surgery and its intricate problems than this collection of papers.

J. A. WOLFER, M.D.

EVERY thinking medical man, in whatever branch of medicine or surgery he may have chosen his special training, must frequently be impressed with the fact that his knowledge is markedly limited on any subject. Invariably the final word is "resistance"; beyond that we know little. Ehrlich's side-chain theory of immunity in its widest interpretation is only a makeshift and takes us only a little farther into a deep mystery. Much as we may know about immunity to infectious diseases, the stability of the nervous system, the influences of heredity, yet there is a distinct barrier in the way to a clear and working conception of many of the problems confronting us today. Infection has been studied not only in the human and animal but in the laboratory with utmost perseverance and skill. Tumor formation is still in the category of ignorance. The clinician and research workers are ever striving to open new paths into the wilderness and jungles of medicine, that the penalties of life may be successfully coped with.

It is with much interest and reverence, therefore, that the recent work of Bandler[1] has been read and reread. The possibilities set forth in this volume are so far reaching and extensive that any review in detail is impossible. Endocrinology, although a comparatively new subject, has been talked and written about for years, without any great advance having been made. Unfortunately, this subject in the past has only too frequently been capitalized by the charlatan, and it requires such men as Bandler and others to take it out of the hands of the Philistines. This master student of life and its phenomena has certainly given us intellectual food as well as a possible explanation for many of the intricate problems of disease. If such is the case, we must rewrite much of our literature and we must change our methods of diagnosis and therapy to a considerable extent.

The author places before the reader his methods of deductions based on observations on the normal and abnormal, as regards the ductless glands. Many of the statements are decidedly radical, and for that reason will probably evoke antagonism in many who do not allow their minds an open sway, unbiased by previous opinions and prejudices. He gives a careful analysis of many of the peculiar mental disturbances and peculiarities which one encounters daily in the practice of medicine, especially those of the young adult female; then he proceeds to associate these with other phenomena which we know are due directly or indirectly to the ductless glands. The deductions on heredity are most interesting; after assaying to explain many of these phenomena on an endocrine basis, the author analyzes the ductless gland problem in a manner which is most convincing. One need only mention hyperthyroidism and cretinism in relation to the thyroid gland; acromegaly, giantism, dwarfism in relation to the pituitary gland; the processes coincident with puberty, menstruation, pregnancy and labor, as concerned with ovary, thyroid and pituitary gland, to arouse immediate and intense interest.

In conclusion a working basis is given, also details as to how to obtain a correct endocrine history and the therapeutic indication. This is illustrated by many case histories. As the author correctly states, every man has in his own practice an experimental laboratory so far as endocrinology is concerned.

Every practitioner of medicine should not only read this volume, but should study it with utmost care and deliberation. There is no doubt that within the next few years much progress will be made along those lines and the medical man who is ignorant on this subject will be decidedly handicapped in his work.

J. A. WOLFER, M.D.

TEXTBOOKS on general surgery are numerous, some very good, others of questionable value. It is exceedingly difficult to estimate the true value of any such work without asking oneself the question, What is this book intended for? The answer should be: To teach the principles of surgery to one who has learned the fundamental branches of medicine. It does not supplant extensive descriptive monographs. It is not designed to make specialists or surgeons of practitioners. It is simply to give the foundation for the study of surgery and must be supplemented by clinical teaching and by work in the experimental laboratory, operating room and pathological laboratory.

With this in view, the recent new work in surgery[2] is of interest. It is prepared by a group of men of no mean ability, all closely associated, thus giving more or less associated ideas. The general plan is the same as is found in practically all works of this

[1] THE ENDOCRINES. By Samuel Wyllis Bandler, A.B., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1920.

[2] SURGERY: A TEXTBOOK BY VARIOUS AUTHORS. Edited by George E. Gask, C.M.G., D.S.O., F.R.C.S.(Eng.), and Harold W. Wilson, M.S, M.B. (Lond.), F.R.C.S. (Eng.). Philadelphia: P. Blakiston's Son & Co., 1920.

class. Nevertheless one is impressed by a certain, what might be called, brief detail of the subjects. No time is lost by the authors to come directly to the point under discussion, the language is clear, and the subject matter unusually well handled.

The one point which stands foremost to the reviewer's mind is the most scientific and clear discussion of general surgical topics, viz., those topics which describe a general condition, such as inflammation, bone repair, bone infection, and many others. This to my mind marks a work of this type either as a success or a failure for teaching and self-instruction. No man can read the masterly description in the introduction to bone transplantation without at once understanding the whole subject of bone reaction. This is carried throughout the book and for this reason places the work far above the average textbook on surgery.

There are few subjects that pertain to surgery that are not mentioned if only in brief. Those topics which deserve elaboration are discussed more fully. Needless to say the thought is necessarily English and much that may be of interest to us, if only for the reason that it has been the result of American study, is omitted. Possibly this is for the better as the surgeon or student should be well grounded in general principles and not cling necessarily to strictly American methods and ideas. There are brief chapters on the diseases of the throat, nose, ear, and eyes, also on the female genitalia. This again may be open to question as there is no doubt that even the medical student must go farther than this brief résumé for his necessary knowledge on these subjects. It seems to the reviewer that this new work deserves decided praise.

Only as a constructive criticism it might be added that the publishers would do well to offer a better binding as in its present state this book would not withstand the average textbook usage.

J. A. WOLFER, M.D.

THE seventh edition of *Surgical Pathology* by Bowlby[1] and Andrewes is at hand. It is with no little satisfaction that this work has been reviewed in its present edition. It seems there is quite a deficiency in American medical literature on this subject. One is inclined to believe that too much emphasis is placed at the present day on surgical technique in the perfection of a surgeon. Technique is necessary and important but withal is not, to the reviewer's mind, the great and final attribute of a surgeon. The many institutes of surgical technique that have sprung up within the past years, should for this reason be cautioned and curtailed. Technique withal is comparatively simple and easily and readily learned in contrast to the recognition of pathological conditions. The latter tries the skill and ability of the operating surgeon. There is no doubt but that this discrepancy is directly responsible for much of the inferior surgery that is practiced at the present time.

The present edition has had chapters added in gas gangrene, shock and tetanus, also many new illustrations. Those chapters devoted to bone and joint pathology deserve especial attention, this subject being discussed in a masterly fashion in the greatest detail. in so far as it applies to surgical relief. The reviewer is rather disappointed in the brief description of gall-bladder and biliary pathology as that subject at present is certainly deserving of considerable attention. Withal the present edition fills a distinct place in medical literature, separate from ordinary texts on pathology and is especially desirable for the student of surgery. The final impression gained is that pathological changes must be seen and felt in order to be recognized.

J. A. WOLFER, M.D.

[1] SURGICAL PATHOLOGY AND MORBID ANATOMY. By Sir Anthony A. Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., and Sir Frederick W. Andrewes, M.D., F.R.S. 7th ed. Philadelphia: P. Blakiston's Son & Co.

AMERICAN COLLEGE OF SURGEONS

THE NEW DEPARTMENT OF LITERARY RESEARCH OF THE AMERICAN COLLEGE OF SURGEONS

THE development of a Department of Literary Research as a new branch of the College's work of advancing the study of surgical problems is the realization of an idea which has been latent in the minds of some of the Founders since the beginning of the College. The most important features in the program of the new Department will be the making of extensive surveys, analyses, and statistical studies based on the work of the Fellows of the College. Through the Department, data on various groups of cases under the care of the Fellows during the preceding year will be collected, correlated, and analyzed from every possible standpoint. At certain stated intervals bulletins will be prepared, giving the results of these surveys arranged in the form of tables, charts, and maps, and accompanied by discussions of certain points which are emphasized, a review of the literature and a complete bibliography on that particular phase of the subject. The results of such surveys will be arranged in graphic form and in a manner which should appeal to both the profession and the laity for use at important meetings of the College, state and national.

Since the College includes in its membership nearly 5,000 surgeons of the United States, Canada and South America, such surveys and statistical researches should bring out many important facts not only as to symptomatology, diagnosis, treatment, and prognosis, but especially as to etiology, and the part played by variations in climate, by heredity, occupation, fatigue, diet, and many other factors in the causation of various conditions. Through such a research center the College should further "serve as an international force to keep before the profession of this hemisphere" a true conception of the great accomplishments and the shortcomings of surgery today. Such a Department will help the surgeon to see the results of American surgery in the large. It will, it is hoped, give an added impetus for research along the lines where the analyses show the possibilities of new theories which need the actual proof of laboratory research to remove them from the realm of empiricism. To stand as a connecting link between the surgeon and the research worker will be the main object of the Department, thus furthering the spirit of the new era of combined research in which, as Sir Berkeley Moynihan so well expresses it, "clinical observation, inductive and deductive processes of reasoning and experimental inquiry are linked together."

The need of such an undertaking is obvious. With the great advances which are continually taking place in medical science, and particularly in those phases related to surgery, the time of the surgeon is largely consumed in learning and making use of the new, approved methods in diagnosis and technique and in keeping in touch with the findings of the great research laboratories which may have a bearing on his particular field, by attending medical meetings and by reading the current medical literature. Only occasionally is it permitted to the average busy surgeon to assume the rôle of the philosopher and pause in the midst of his work to make extensive surveys and statistical studies on the various phases of the special subject in which he is most interested. When he does so, the survey is almost invariably confined to a review of the work of his own clinic or to a compilation of the cases recorded in surgical literature and, inasmuch as a man chooses for varying reasons the particular case which he publishes, a survey based on such a compilation can never be a true criterion of conditions as they actually exist.

While various individual surveys have been made from time to time by different societies no organization has attempted a large series of systematic surveys, analyses, and statistical studies based on the current work of a large body of surgeons. Yet in what field is it more necessary to stop and survey things as they are, to analyze carefully the details of the work just passed, that one may have a clearer vision for the future? By carrying on such surveys and statistical studies, the College will be able to do for the Fellows collectively what each Fellow is unable to do for himself, and each Fellow through the College will be contributing to the progress

of science in a way that he could not possibly do alone.

It is earnestly hoped that each Fellow will feel that he has an active part to take in this new work. In order that the surveys may be complete and the bulletins prepared for distribution to the Fellows of the College, it will be necessary that each Fellow send in promptly the data requested. It will be a work by the Fellows of the College and for the Fellows of the College, and a means by which the Fellows, individually and collectively, will be furthering the great advances already taking place in American surgery. Absolutely no personal record will be kept of the statistical data, the entire purpose of the undertaking being the assembling of cases in the large and the analysis of such cases *en masse*.

Another phase of the work of the new Department will be the assistance of authors in the preparation of papers, monographs, and books on medical subjects. The Department will be glad to help Fellows in their medical literary work through the preparation of bibliographies, abstracts, and translations on any given subject related to general surgery or the surgical specialties, the compilation of such material, or any other editorial work which may be desired. For such literary research, the Department will have the use of the John Crerar Library, one of the most complete medical libraries in the country, until the College Library shall become the large reference library which we hope that it may in the future. A charge will be made for such assistance to cover the actual expense of the work.

HOSPITAL STANDARDIZATION

THE hospital survey of the College for 1921 is nearing completion. The policy this year has been to pay particular attention to hospitals which either were not on the approved list last year or which appeared on the list with an asterisk. The asterisk on the approved list for 1920 indicated institutions which, when visited, did not fully meet the standard but which subsequently reported that the requirements of the minimum standard were fulfilled. The hospitals which were listed last year as being fully approved are not, as a general routine, being visited this year. Many additional hospitals having a capacity of between fifty to one hundred beds have been visited, so that by the end of this year the majority of these smaller institutions will have been surveyed.

It is gratifying to note that in most instances the institutions which appeared on the approved list with an asterisk last year have been found acceptable. Distinct improvement has been noted also in many of the institutions which did not appear on the approved list in 1920.

The work in the United States has been distributed among seven visitors, as follows: Dr. M. R. Broman in Western Texas, Arizona, California, Oregon, Washington, Utah, Idaho, Montana, and Colorado; Dr. B. R. Weston in Kentucky, West Virginia, Virginia, North Carolina, Tennessee, Missouri, Iowa, parts of Minnesota, and North and South Dakota; Dr. John G. Cheetham in southern Ohio, Maryland, Pennsylvania, and Chicago; Dr. C. T. Stephan in Oklahoma, Arkansas, Kansas, Western Missouri, Nebraska, Western Iowa, Minnesota, Michigan, northern Ohio, and New York state; Dr. B. W. Lowry in Texas, Louisiana, Alabama, Mississippi, Florida, Georgia, South Carolina, Delaware, New York City and Brooklyn, Connecticut, Rhode Island, Massachusetts, Maine, New Hampshire, and Vermont; Dr. L. D. Moorhead in Indiana and Illinois; Dr. J. L. Smith in Wisconsin.

PROGRESS IN CANADA

Dr. T. R. Ponton, assistant superintendent of the Vancouver General Hospital, Vancouver, British Columbia, is making a survey of the Canadian hospitals for the American College of Surgeons. All general hospitals having a capacity of fifty or more beds are being visited. Dr. Ponton began his tour on May 22 and has already visited most of the Canadian hospitals. There are 154 general hospitals in Canada each having a capacity of over fifty beds; of these 89 have over one hundred beds and 65 have less than one hundred beds.

In 1920 there were 22 Canadian hospitals on the approved list of the College. From the preliminary reports already received, the report for 1921 in all probability will show a substantial increase.

The various provincial organizations have been active in improving hospital conditions. Indeed, as a result of their co-operation the program of hospital standardization has been markedly enhanced.

The Ontario Medical Association recently held its forty-first annual meeting in Niagara Falls. Dr. J. Heurner Mullin, in his presidential address, emphasized the need for an elaboration of the

hospitalization program, particularly with reference to the hospitals in the smaller communities. Dr. Mullin stated in part:

"Our hospital beds must be increased in number. Patients no longer find it convenient or possible to remain in their homes. The question of shortage of nursing aid, both fully trained or otherwise, or even domestic help, drive many to hospita's who would have preferred to have stayed at home. Many problems in careful diagnosis and treatment, whether medical or surgical, can be properly taken care of only in a well organized hospital.

"We must make provision to elaborate an extensive hospitalization program, which will take into consideration the actual needs in all of our small communities. It should be unnecessary for many of the patients and their friends to travel miles from home to some famous clinic, often at great expense and personal risk or injury. Each of these community hospitals should be thoroughly standardized according to a minimum plan.

"Those interested directly in the administration of such hospitals should not be satisfied until all members of the community where they are located will have the privilege of, and reason for, a complete confidence in the work conducted therein.

"A plan for hospital standardization has been developed which depends on the following features: (a) careful preparation and care of all scientific records; (b) complete laboratory service to assist in this; (c) careful study of such records by the group of medical men attending each institution.

"The study of these records, in an impersonal manner, will supply an abundance of clinical material not otherwise available. This plan of hospital standardization is no fairy story or fantastic dream, but is in actual operation in scores of institutions on this continent today. This does not seem much to ask when the interests of the public are vitally concerned.

"This community hospital becomes the health center of the district, the place of meeting for the local practitioners, a democratic and unselfish group clinic wherein we can continuously provide a system for the development of the general man along scientific lines."

Further, a clear cut attitude toward the practice of fee-division was expressed by Dr. Mullin:

"The buying and selling of patients, otherwise called fee-splitting, is another example of commercial enterprise and should be prevented by some amendment to the Criminal Code. The taking of any part of fees by any system of secret graft, without actual service rendered, and without the knowledge of the patient, should more properly be called 'theft.'

"If the specialist is not too busied with an egotistical appreciation of his own importance, he should recognize the part which the well trained general man takes in the community—services more valuable on critical occasions than any money can repay. The honest consultant should use every possible opportunity for assisting the public properly to understand the value of such services, and to pay a reasonable honorarium for the same. The real consultant should recognize his continuous duty in this education propaganda. In the future many of our now so-called special procedures will become routine with all general practitioners."

The hospital standardization committee of the Ontario Medical Association, with Dr. E. R. Secord as chairman, presented a report recommending certain hospital essentials dealing with staff organization, official action prohibiting the practice of fee-division, rules and regulations, monthly analytical staff meetings, case records, and laboratory facilities. Hence, the recommendations of the Ontario Medical Association are in close harmony with the minimum standard of the College, which is as follows:

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, policies specifically provide:

   a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

   b. That the staff review and analyze at regular intervals the clinical experience of the staff in the

various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnoses, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians.

In closing, Dr. Secord said:

"It would seem evident that these requirements are all in the best interests of the patient, which should be the first consideration in every hospital. It would seem that they are indeed the minimum requirements by which hospitals can best serve the sick of a community."

The committee further recommended that questionnaires be sent to all hospitals in the provinces, requesting information as to the process of staff selection and concerning the status of the hospitals with reference to the minimum standard.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ELEVENTH ANNUAL SESSION, PHILADELPHIA, OCTOBER 24–28, 1921

GEORGE E. ARMSTRONG, Montreal, *President*
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PHILADELPHIA AS A CLINICAL CENTER

BY GEORGE P. MULLER, M.D., PHILADELPHIA

IT is not in a spirit of boasting but with honest pride that Philadelphia looks upon itself as the center of clinical medicine in America. In this country, where everything is looked upon as being new, and institutions regarded as infantile in comparison with European institutions, we can with measurable pride look toward Philadelphia as the origin of medical education in America.

The first school of medicine to be founded in this country was in Philadelphia in 1765, when the present Medical School of the University of Pennsylvania was founded as a part of the "College Academy and Charitable School." Some years before this, in May, 1751, by act of the Provincial Assembly a law was passed "to encourage the establishment of a hospital for the relief of the sick poor of this province and for the reception and cure of lunaticks," and was approved by the Governor on the 11th of May, 1751. By this act a corporation was created by the name of "the Contributors of the Pennsylvania Hospital." This hospital is located on Spruce Street between Eighth and Ninth and some of the original buildings facing Pine Street are still intact.

In 1874 the University Hospital was founded to affiliate with the Medical School of the University of Pennsylvania, which was moved to its present site, and the original building still stands with its numerous additions.

The Philadelphia General Hospital was founded in 1732 as the Philadelphia Almshouse. Shortly thereafter a medical infirmary was added. This makes it probably the oldest hospital in the United States, being antedated only by the Hotel Dieu of Montreal and some Mexican hospitals. It was moved to its present site at Thirty-fourth and Pine Streets in 1832. In the early colonial days Benjamin Rush, William Shippen, John Morgan, and Thomas Bond were among its visiting physicians and since that time practically every name known to Philadelphia medicine was in some way or other connected with Blockley. It is estimated that approximately 56,000 medical students have received medical instruction at this hospital. The site at Tenth and Spruce streets, before its removal to the present site, was the supposed location of the final scene in Longfellow's *Evangeline*. In more recent years such names as Osler, Mitchell, Gross, Tyson, and Pepper have been connected with "Old Blockley" as it is affectionately called.

With a population of nearly two million, Philadelphia supports five medical schools: the Medical School of the University of Pennsylvania, Jefferson Medical College, the Woman's Medical College, Hahnemann Medical College, and the Medical School at Temple University. Until 1916 the Medico-Chirurgical College of Philadelphia existed as a separate institution, but in that year this school merged with the Univer-

sity of Pennsylvania for the establishment of the Medico-Chirurgical College and Hospital, Graduate School of Medicine of the University of Pennsylvania. In 1918 the Philadelphia Polyclinic and College for Graduates in Medicine also merged with the University and has since been known as the Polyclinic section of the Graduate School. This expansion in graduate medical instruction marked a new era for Philadelphia as a clinical center; for, while heretofore, graduate instruction had been given in Philadelphia it was not given in a systematic manner covering all the specialties in medicine and surgery. Thus, each year Philadelphia is able to send forth practitioners to wider duties, enriched by the experience of men with large clinical experiences covering many years of practice.

And so the work which had its foundation in the early part of the eighteenth century has grown and multiplied through the wisdom, forethought, courage, and energy of the early pioneers such as Benjamin Rush, John Physik, the elder Gross, Keen, Ashhurst, and Agnew.

It is hardly necessary to mention the great historical interest possessed by Philadelphia. The first Continental Congress met here in 1774 in Carpenter's Hall, and in Independence Hall at Seventh and Chestnut streets the Declaration of Independence was debated and signed and the United States Constitution adopted. The famous Liberty Bell is preserved here. These institutions are open for inspection, as are many other places of historical interest including the Betsy Ross House, Christ Church, Congress Hall, etc.

The suburban section around Philadelphia is beautifully developed and offers many miles of finely paved avenues for automobile touring. The famous watering place, Atlantic City, is connected by an almost straight concrete and asphalt road extending across the State of New Jersey.

PLANS FOR THE PHILADELPHIA MEETING

A preliminary outline of the program for the evening sessions for the Philadelphia meeting, as arranged by the Executive Committee of the Clinical Congress, will be found in the following pages. The Congress formally opens with the presidential meeting on Monday evening in the Ballroom of the Bellevue-Stratford. On this occasion the distinguished foreign guests will be presented, and the President-elect, Dr. John B. Deaver, of Philadelphia, will deliver his inaugural address. Dr. William J. Mayo of Rochester will deliver the John B. Murphy Oration in Surgery. On Tuesday, Wednesday, and Thursday evenings papers dealing with surgical subjects of present-day importance will be read by a number of distinguished European and American surgeons.

Monday will be devoted to a series of conferences on matters relating to the hospital standardization program of the American College of Surgeons. These conferences will be held in the Ballroom of the Bellevue-Stratford beginning at 9 a.m. and 2 p.m. A complete program for these conferences will be published in the next issue of this journal.

The general plan of previous sessions will be followed — operative clinics and demonstrations in the hospitals and medical schools will occupy the morning and afternoon hours of the four days, Tuesday to Friday inclusive, with scientific meetings each evening in the ballroom at the Bellevue-Stratford.

A preliminary schedule of the clinics and demonstrations to be given by the clinicians of Philadelphia is presented in the following pages. This published schedule is a tentative one and will be amplified and corrected during the following weeks as the work of the Committee on Arrangements progresses, so that the final program will fully represent the clinical activities of that great medical center, providing a complete showing of its facilities in every department of surgery, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc. The real program of the Congress, however, is that to be bulletined each afternoon at headquarters, which will present an accurate and detailed list of the operative clinics and demonstrations to be given in the several hospitals and medical schools on the succeeding day.

For the benefit of those especially interested in surgery of the eye, ear, nose, and throat, the Committee is arranging a series of special clinical demonstrations to be given each morning at 9 o'clock in one of the large rooms at the Bellevue-Stratford. Complete details with regard to this special feature will be published in the next issue of this journal.

COLLEGE CONVOCATION

On Friday evening fellowship in the American College of Surgeons will be conferred upon a large group of American and Canadian surgeons at the ninth annual convocation of the College to be held in the ballroom. At the same time honorary

fellowships will be conferred upon the distinguished foreign guests.

An interesting and decidedly unique feature of the convocation will be the conferring of honorary fellowships in the Royal College of Surgeons of Ireland upon a group of distinguished American surgeons. Sir William I. de Courcy Wheeler, Vice-President, Sir Robert Hy Woods, past President, and Sir William Taylor, K.B.E., C.B., past President, representing the Irish College, will confer fellowships upon the following: George E. Brewer, George W. Crile, John M. T. Finney, Richard H. Harte, William W. Keen, Charles H. Mayo, William J. Mayo, Albert J. Ochsner.

REDUCED RAILWAY FARES

The railways of the United States and Canada have, with but few exceptions, authorized the sale of round-trip tickets to Philadelphia on account of the Clinical Congress at one and one-half the ordinary one-way fare, provided that the journey be made by the same route both going to and returning from Philadelphia. Such special round trip tickets will be sold to members only upon presentation of identification certificates issued from the office of the Secretary-General. Identification certificates will be issued upon application to all who register. One certificate is good for the member and dependent members of his family. Under this special arrangement round-trip tickets will be sold from October 20 to 26 except in the far western states where the earliest selling date is October 19. The return limit is November 3, except in western states where the limit is November 4. Further detailed information with regard to fares and traffic arrangements will be published in the next issue of this journal.

HEADQUARTERS

General headquarters for the Congress will be at the Bellevue-Stratford Hotel where the entire first floor has been reserved for the use of the Congress. The large ballroom will be utilized for the evening sessions, certain clinical demonstrations, business meetings, etc., while the Clover, Red, Green, and other large rooms and foyers on the same floor will provide ample space for registration and ticket bureaus, bulletin rooms, etc. Headquarters will be open for registration at noon, Monday, October 24th. The clinical program for Tuesday will be bulletined at headquarters that afternoon, and tickets for Tuesday's clinics will be issued as visiting surgeons register.

PHILADELPHIA HOTELS

In addition to the Bellevue-Stratford, headquarters hotel, Philadelphia has a number of first-class hotels. In the immediate vicinity of the Bellevue-Stratford are the Adelphia, Ritz-Carlton, Walton, and St. James. A complete list of the hotels recommended by the local Committee on Arrangements is as follows:

Adelphia, 13th and Chestnut.
Aldine, 19th and Chestnut.
Belgravia, 1811 Chestnut.
Bellevue-Stratford, Broad and Walnut.
Blenheim, 17th and Chestnut.
Colonial, 11th and Spruce.
Colonnade, 15th and Chestnut.
Continental, 9th and Chestnut.
Dooners', 23 S. 10th.
Green's, 8th and Chestnut.
Hanover, 12th and Arch.
Longacre, 1431 Walnut.
Lorraine, Broad and Fairmount.
Rittenhouse, 22nd and Chestnut.
Ritz-Carlton, Broad and Walnut.
Royal Apartments, Broad and Girard.
St. James, 13th and Walnut.
Stenton, Broad and Spruce.
Vendig, 13th and Filbert.
Walton, Broad and Locust.
Windsor, 1217 Filbert.

LIMITED ATTENDANCE — ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting the attendance, requiring registration in advance on the part of those who wish to attend. A survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools, as to their capacity for accommodating visitors, has been made and the limit of attendance based thereon.

This plan insures accommodations at the clinics for all who register in advance, and the necessity for adopting such a plan will be apparent to all. Based upon our experience at previous meetings, it is probable that the limit of attendance will be reached weeks in advance of the meeting. When the limit of attendance has been reached through advance registration, no further applications can be accepted.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic or demonstration being limited to the capacity of the room in which the clinic or demonstration is to be given.

Clinic tickets will be issued at headquarters each morning at 8 o'clock for the clinics and demonstrations to be given that day, except that for Tuesday's clinics the tickets will be

issued on Monday as the visiting surgeons register. Each afternoon a complete schedule of the following day's clinics will be posted on bulletin boards at headquarters. After the program has been posted, reservations for tickets for the clinics may be filed, the tickets to be issued the following morning. Printed programs will be issued each morning.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, the receipts from registration fees providing the funds with which to meet the expenses of conducting the meeting, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

A formal receipt for the registration fee is issued to each surgeon registering in advance, which receipt is to be exchanged for a general admission card at headquarters upon his arrival in Philadelphia. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

Preliminary program of evening sessions and schedule of clinics and demonstrations will be found on the following pages.

PROGRAM FOR EVENING MEETINGS

IN THE BALLROOM OF THE BELLEVUE-STRATFORD HOTEL, AT 8 P.M.

Presidential Meeting, Monday, October 24

Address of Welcome: GEORGE P. MULLER, M.D., Philadelphia, Chairman, Committee on Arrangements.

Address of the retiring President: GEORGE E. ARMSTRONG, M.D., Montreal.

Introduction of foreign guests: SIR HAROLD J. STILES, K.B.E., Edinburgh; SIR WILLIAM TAYLOR, K.B.E., C.B., Dublin; SIR WILLIAM I. DE COURCY WHEELER, F.R.C.S.I., Dublin; SIR ROBERT HY WOODS, F.R.C.S.I., Dublin; PROFESSOR H. C. JACOBAEUS, Stockholm; J. SCHOEMAKER, M.D., The Hague; PROFESSOR F. DE QUERVAIN, Berne.

Inaugural Address: JOHN B. DEAVER, M.D., Philadelphia.

SIR WILLIAM I. DE COURCY WHEELER, F.R.C.S.I., Dublin: Random Thoughts on Surgical Topics.

The John B. Murphy Oration on Surgery: WILLIAM J. MAYO, M.D., Rochester, Minnesota.

Tuesday, October 25

SYMPOSIUM: Sarcoma of the Long Bones.

JOSEPH C. BLOODGOOD, M.D., Baltimore: Diagnosis and Pathology (illustrated).

WILLIAM B. COLEY, M.D., New York: Conservative Treatment.

ERNEST A. CODMAN, M.D., Boston: Pathologic Fractures.

HENRY W. MEYERDING, M.D., Rochester, Minn.: A Study of Microscopically Proven Cases and End Results.

Discussion: A. P. C. ASHHURST, M.D., Philadelphia; FREDERIC A. BESLEY, M.D., Chicago.

SIR HAROLD J. STILES, K.B.E., Edinburgh: Neuritis Due to Pressure of First Rib upon Brachial Portion of First Thoracic Nerve.

PROFESSOR H. C. JACOBAEUS, Stockholm: Thorascopy and Its Practical Importance for Surgery of the Chest.

Wednesday, October 26

SYMPOSIUM: Reconstruction Surgery.

ALLEN B. KANAVEL, M.D., Chicago: Reconstruction Surgery of the Hand

VILRAY P. BLAIR, M.D., St. Louis: Reconstruction Surgery of the Face.

NATHANIEL ALLISON, M.D., St. Louis: Surgery of Impaired Joint Function.

Discussion: ROBERT H. IVY, M.D., Philadelphia; A. BRUCE GILL, M.D., Philadelphia.

J. SCHOEMAKER, M.D., The Hague, Holland: Some Technical Points in Abdominal Surgery.

SYMPOSIUM: Gynecology and Obstetrics.

THOMAS S. CULLEN, M.B., Baltimore: Abdominal Surgery.

JOHN OSBORN POLAK, M.D., Brooklyn: The Present Status of Operative Obstetrics, Referring to the Abuse of Cæsarean Section.

Discussion: BROOKE M. ANSPACH, M.D., Philadelphia; EDWARD P. DAVIS, M.D., Philadelphia; BARTON COOKE HIRST, M.D., Philadelphia.

Thursday, October 27

SYMPOSIUM: Gall-Bladder Surgery.

HARRY M. RICHTER, M.D., Chicago: Gall-Bladder Surgery, with Special Reference to Closure of the Abdomen without Drainage.

GEORGE W. CRILE, M.D., Cleveland: The Technique of Gall-Bladder Surgery in the Presence of Jaundice.

Discussion: ACHILLE M. WILLIS, M.D., Richmond; GEORGE P. MULLER, M.D., Philadelphia; JOHN T. BOTTOMLEY, M.D., Boston; E. W. ARCHIBALD, M.D., Montreal.

PROFESSOR F. DE QUERVAIN, Berne, Switzerland: Relation Between the Histological Aspect and the Clinical and Epidemiological Peculiarities of Goiter.

SYMPOSIUM: Nerve Suture.

DEAN LEWIS, M.D., Chicago: End Results.

Discussion: CHARLES H. FRAZIER, M.D., Philadelphia; G. CARL HUBER, M.D., Ann Arbor.

Convocation of the American College of Surgeons, Friday, October 28

Invocation: D. CARDINAL DOUGHERTY, Archbishop of Philadelphia.
Conferring of Honorary Fellowships.
Presentation of Candidates for Fellowship.
Presidential Address: JOHN B. DEAVER, M.D., Philadelphia.
Fellowship Address: SIR HAROLD J. STILES, K.B.E., Edinburgh.

The following distinguished South American surgeons are also expected to attend the Clinical Congress: DR. MARCELINO HERRERA VEGAS, Buenos Aires, Argentina; DR. CLAUDIO SANJINES, LaPaz, Bolivia; DR. J. ALVES DE LIMA, São Paulo, and Dr. JOSE MENDONÇA, Rio de Janeiro, Brazil; SURGEON-GENERAL ALBERTO ADRIASOLA, Valparaiso: DR. GREGORIO AMUNATEGUI and DR. LUCAS SIERRA, Santiago, Chile; DR. MIGUEL H. ALCIVAR, Guayaquil, Ecuador; DR. GUILLERMO GASTAÑETA and DR. FRANCISCO GRAÑA, Lima, Peru; DR. ENRIQUE POUEY, Montevideo, Uruguay.

PRELIMINARY CLINICAL PROGRAM

PHILADELPHIA GENERAL HOSPITAL

Tuesday, October 25

H. W. LOUX—9. General surgery.
J. T. RUGH—11. Orthopedics.
M. M. FRANKLIN—3:30. Orthopedics.

Wednesday, October 26

T. T. THOMAS—9. General surgery.
E. R. KIRBY—12. Genito-urinary surgery.
E. B. KRUMBHAAR—2. Exhibition of radium plant.
F. O. LEWIS—3:30. Laryngology.

Thursday, October 27

JOHN FISHER—9. Gynecology.
J. C. HIRST—10:30. Gynecology.

Friday, October 28

H. R. OWEN—9. General surgery.
R. H. IVY—11:30. Oral surgery.

POLYCLINIC HOSPITAL

Tuesday, October 25

DEF. P. WILLARD—9. Orthopedics.
T. B. HOLLOWAY—2. Ophthalmology.
R. BUTLER—2. Nose and throat clinic.

Wednesday, October 26

J. K. YOUNG—9. Orthopedics.
L. C. PETER—2. Ophthalmology.
C. B. GLEASON—2. Otology.

Thursday, October 27

W. C. ELMER—9. Orthopedics.
C. F. MARTIN—11. Proctology.

Friday, October 28

J. B. ROBERTS—9. Plastic surgery.
B. A. THOMAS—2. Urology.
G. B. WOOD—2. Tonsil clinic.

PRESBYTERIAN HOSPITAL

Tuesday, October 25

J. H. JOPSON and D. B. PFEIFFER—9. General surgery.
A. B. GILL—12. Orthopedics.
J. H. GIRVIN—2. Gynecology.
RALPH PEMBERTON—2. Present status of pathology and treatment of arthritis, with exhibition of patients.
RALPH PEMBERTON, B. A. THOMAS, N. P. STAUFFER, J. E. AIGUIER and assistants—2:45. Brief analysis of incidence of various types of focal infection in one hundred consecutive admissions to the medical service.
A. B. GILL—3. Treatment of tuberculous arthritis (exhibition of patients).
J. H. JOPSON—3:30. Discussion of fractures into joints.
H. P. BROWN—4. Results of Willems' treatment.

Wednesday, October 26

G. E. SHOEMAKER—9. Gynecology.
B. A. THOMAS—2. Urology.

Thursday, October 27

JOHN SPEESE, J. S. RODMAN and H. P. BROWN—9. General surgery.

Friday, October 28

J. H. JOPSON and D. B. PFEIFFER—9. General surgery.
N. P. STAUFFER—2. Nose and throat.

CHILDREN'S HOSPITAL (MARY J. DREXEL HOME)

Wednesday, October 26

RALPH BUTLER—8. Mastoid operations.
N. L. KNIPE—2. Ophthalmology.

Friday, October 29

H. C. DEAVER AND E. G. ALEXANDER—10:30. General surgery.

UNIVERSITY HOSPITAL

Tuesday, October 25

B. C. HIRST, E. B. PIPER, and J. C. HIRST, 2nd—9. Obstetrics and gynecology.
GEORGE G. ROSS—9. Hernia operations.
F. E. KEENE and CHARLES C. NORRIS—9. Gynecology.
J. B. CARNETT—11. General surgery.
E. L. ELIASON—12. General surgery.
A. B. GILL—10. Orthopedics.
B. C. HIRST, E. B. PIPER, J. C. HIRST, 2nd., and C. C. WOLFERTH—2. Obstetrical and gynecological complications; cardiac conditions complicating pregnancy.
J. E. SWEET—2. Experimental surgery.
A. B. GILL—2. Orthopedics.
CHARLES H. FRAZIER—3:30. Surgery of the nervous system.

Wednesday, October 26

CHARLES H. FRAZIER and FRANCIS GRANT—9:30. Surgery of the nervous system (operations).
F. E. KEENE and CHARLES C. NORRIS—9. Gynecology.
D. B. PFEIFFER—9. General surgery.
THOMAS R. NEILSON and ALEX RANDALL—11. Urology.
GEORGE P. MULLER and H. K. PANCOAST—2. Malignant disease of the face and mouth.
F. E. KEENE and CHARLES C. NORRIS—2. Gynecological demonstration.
J. E. SWEET—2. Experimental surgery.
H. K. PANCOAST—3. Roentgenology.
D. B. PFEIFFER—3. Rectal carcinoma.
T. T. THOMAS—3:30. Shoulder dislocations.
J. B. CARNETT and E. L. ELIASON—4. Demonstrations of a fracture.

Thursday, October 27

B. C. HIRST, E. B. PIPER, J. C. HIRST, 2nd—9. Gynecology and obstetrics.
F. E. KEENE and CHARLES C. NORRIS—9. Gynecology.
GEORGE P. MULLER—9. Surgery of the chest.
C. H. FRAZIER AND FRANCIS GRANT—9:30. Neurological surgery.
A. B. GILL—10. Orthopedics.
T. T. THOMAS—11. General surgery.

Friday, October 28

F. E. KEENE and CHARLES C. NORRIS—9. Gynecology.
A. C. WOOD—9. General surgery.
C. H. FRAZIER and FRANCIS GRANT—9:30. Surgery of the nervous system and goiter.
JOHN B. DEAVER—10:30. General surgery.
J. E. SWEET—2. Experimental surgery.
CHARLES E. GRAYSON—2. Otolaryngology.
CHARLES H. FRAZIER and FRANCIS GRANT—2. Surgery of the nervous system and goiter.
H. K. PANCOAST—3. Roentgenology.
DRS. DEAVER, WOOD, ROSS, MULLER, CARNETT, ELIASON, PFEIFFER, STENGEL, PEPPER, FOX, RICHARDS, MILLER, WOLFERTH, KERN—3. Joint clinic on medical aspect of surgical cases and vice versa.

ORTHOPEDIC HOSPITAL

Tuesday, October 25

A. BRUCE GILL—9. Orthopedics.
WILLIAM J. TAYLOR—11. Orthopedics.
A. P. C. ASHHURST and EDWARD T. CROSSAN—2. Demonstration: tarsectomy for rigid flat foot, inveterate club foot, and equinovarus; birth injuries of shoulders; lacerations of brachial plexus.

PENNSYLVANIA HOSPITAL

Tuesday, October 25

W. D. STROUD—9. Electrocardiogram.
DR. MACMILLAN—9. Basal metabolism.
D. R. BOWEN—10. Roentgenology.
DR. NEWCOMER—10. Surgical pathology.
DRS. LECONTE, LEE, and BROWN—11. General surgery.
L. J. HERMAN—1. Genito-urinary surgery.
E. A. STRECKER—1. Neurology.
DRS. PACKARD, EVES, and DAVIES—2. Ear, nose, and throat.
DRS. SHOEMAKER and CRAMPTON—2. Eye clinic.

Wednesday, October 26

W. D. STROUD—9. Electrocardiogram.
DR. MACMILLAN—9. Basal metabolism.
D. R. BOWEN—10. Roentgenology.
DR. NEWCOMER—10. Surgical pathology.
G. W. NORRIS—10. Medical clinic.
DRS. GIBBON, BILLINGS, and KLOPP—11. General surgery.
DRS. SHOEMAKER and CRAMPTON—2. Eye clinic.
DRS. PACKARD, EVES, and DAVIES—2. Ear, nose, and throat.
F. C. KNOWLES—2. Skin.

Thursday, October 27

W. D. STROUD—9. Electrocardiogram.
DR. MACMILLAN—9. Basal metabolism.
D. R. BOWEN—10. Roentgenology.
DR. NEWCOMER—10. Surgical pathology.
A. NEWLIN—10. Medical clinic.
DRS. MITCHELL, LEE, and BROWN—11. General surgery.
L. J. HERMAN—1. Genito-urinary surgery.
DRS. NEWCOMER, DAVIS, and KNOWLES—2. Syphilis: Salvarsan.
E. A. STRECKER—2. Neurology.
DRS. SHOEMAKER and CRAMPTON—2. Eye clinic.
DRS. PACKARD, EVES, and DAVIES—2. Ear, nose, and throat.

Friday, October 28

W. D. STROUD—9. Electrocardiogram.
DR. MACMILLAN—9. Basal metabolism.
DR. NEWCOMER—10. Surgical pathology.
D. R. BOWEN—10. Roentgenology.
T. MCCRAE—10. Medical clinic.
DRS. GIBBON, BILLINGS, and KLOPP—11. General surgery.
DRS. PACKARD, EVES, and DAVIES—2. Ear, nose, and throat.
DRS. SHOEMAKER and CRAMPTON—2. Eye clinic.

JEFFERSON HOSPITAL

Tuesday, October 25

J. T. RUGH—9. Orthopedics.
E. P. DAVIS—10. Obstetrics.

Wednesday, October 26

BROOKE M. ANSPACH—9. Gynecology.
J. CHALMERS DACOSTA—2. General surgery.

Thursday, October 27

H. R. LOUX—10. Urology.
CHEVALIER JACKSON—2. Bronchoscopy.

Friday, October 28

JOHN H. GIBBON—10. General surgery.
S. MACCUEN SMITH—2. Otology.
WILLIS F. MANGES—2. Roentgenology.

MEDICO-CHIRURGICAL HOSPITAL

Tuesday, October 25

GEORGE P. MULLER and staff—9. Surgical clinic—operations and demonstrations.
J. A. KOLMER and E. A. CASE—9:30. Demonstration—frozen section work.
E. A. MCKNIGHT—2. Demonstration—fractures of the forearm.
R. H. SKILLERN—2. Sinus clinic.
R. F. RIDPATH—2. Tonsil clinic.
WILLIAM BATES—2:15. Demonstration—fractures of the tibia and fibula.
B. R. BELTRAN—2:30. Demonstration—fractures of the femur.
I. S. RAVDIN—2:45. Demonstration—postoperative cases of compound fracture.
T. T. THOMAS—3:00. Recurrent dislocation of the hip and shoulder. Demonstration of cases and anatomical specimens.
L. W. FOX—3. Ophthalmic clinic.
JOHN H. JOPSON—3:30. Demonstration—fractures of the carpal and tarsal bones.
GEORGE P. MULLER—3:45. Demonstration—fractures of the skull.
ROBERT H. IVY—4. Demonstration—fractures of the mandible.

Wednesday, October 26

JOHN H. JOPSON—9. Surgical clinic.
WILLIAM R. NICHOLSON and staff—9. Gynecology.
GEORGE W. OUTERBRIDGE—2. Demonstration—cystoscopy.
G. M. COATES—2. Tonsil clinic.
M. ERSNER—2. Tonsil clinic.
T. F. JAFFE—2:15. Demonstration—gynecological models.
WILLIAM R. NICHOLSON—2:30. Demonstration—postoperative gynecological cases.
DEFORREST P. WILLARD—2:45. Demonstration—cases of hip joint disease.
WALTER G. ELMER—3. Demonstration—cases of Potts' disease.
JAMES M. ANDERS—3:15. Demonstration—cases of aneurism.
GEORGE M. PIERSOL and staff—3:30. Demonstration of cases for gastro-enterologic study.
MRS. M. S. STEELE—3:45. Speech clinic.
MISS H. E. KIRSH—4. Surgical social service.

Thursday, October 27

ERNEST LAPLACE and staff—9. Surgical clinic and demonstrations.
GEORGE M. BOYD and staff—9. Gynecological clinic.

Friday, October 28

J. B. CARNETT—9. Surgical clinic.
M. B. MILLER—9. Surgical clinic.
GEORGE E. PFAHLER—2. Electro-coagulation clinic with demonstration of cases.
DRS. SKILLERN, RIDPATH, COATES and ERSNER—2. Nose and throat clinic.
L. W. FOX—2. Ophthalmic clinic.
ROBERT H. IVY—3. Demonstration—postoperative results in maxillofacial surgery.
M. B. MILLER—3:15. Demonstration of cases of cervical-adenitis treated with tuberculin.
J. STEWART RODMAN—3:30. Demonstration—neurological surgery.
P. G. SKILLERN—3:40. Demonstration—new method in operative technique.

LANKENAU HOSPITAL

Tuesday, October 25

R. BUTLER and J. A. BABBITT—2. Otolaryngology.
W. T. SHOEMAKER and E. A. SHUMWAY—2. Ophthalmology.
MISS JASTROW—2. Follow-up system.
W. H. MACKINNEY—3. Urology.
S. P. REIMANN—3. Clinical laboratory methods.
A. G. MILLER and R. SHOEMAKER, 3rd—3. Roentgenology: fractures and joint injuries.

Wednesday, October 26

J. B. DEAVER, G. G. ROSS, and A. D. WHITING—9. General surgery.
MISS JASTROW—2. Follow-up system.
R. BUTLER and J. A. BABBITT—3. Otolaryngology.
W. T. SHOEMAKER and E. A. SHUMWAY—3. Ophthalmology.

Thursday, October 27

J. B. DEAVER, G. G. ROSS and A. D. WHITING—9. General surgery.

Friday, October 28

S. P. REIMANN—2. Pathological demonstrations.
A. G. MILLER and R. SHOEMAKER, 3rd—2. Roentgenology: fractures and joint injuries.
W. H. MACKINNEY—3. Urology.

METHODIST HOSPITAL

Tuesday, October 25

WILLIAM R. NICHOLSON—9. Gynecology.
J. H. BALDWIN—11. General surgery.
M. F. PERCIVAL—11. Roentgenology.
WALTER ROBERTS—2. Nose and throat.
PHILIP H. MOORE—2. Ophthalmology.

Wednesday, October 26

G. G. ROSS—9. General surgery.
RICHARD NORRIS—11. Gynecology and obstetrics.

Friday, October 28

J. T. RUGH—9. Orthopedics.
J. K. HERMAN—11. Genito-urinary surgery.
L. J. HAMMOND—2. General surgery.

HOWARD HOSPITAL

Tuesday, October 25

A. C. WOOD—9. General surgery.
E. L. ELIASON—11. General surgery.
GEORGE B. WOOD—2. Nose and throat.
R. J. HUNTER and S. COHEN—3. Nose and throat operations.

Wednesday, October 26

BERNARD MANN—9. Gynecology.
BARTON COOKE HIRST—11. Gynecology.
W. C. POSEY—2. Eye clinic.

Thursday, October 27

A. C. WOOD—9. General surgery.
E. L. ELIASON—11. General surgery.
GEORGE B. WOOD—2. Nose and throat.

Friday, October 28

BERNARD MANN—9. Gynecology.
BARTON COOKE HIRST—11. Gynecology.
W. C. POSEY—2. Eye clinic.

ST. AGNES' HOSPITAL

Tuesday, October 25

G. M. DORRANCE and staff—9. General surgery.
J. M. FISHER—9. Repair of pelvic floor; amputation of cervix; hysterectomy for fibroids of the uterus; hysterectomy for carcinoma of the uterus; operative correction for displacements of the uterus; operations in cases of pelvic inflammatory diseases.
G. M. DORRANCE and L. E. MCCREA—11. Plastic operations on the face and neck with cases showing results of operations.
B. D. PARRISH—2. Demonstration of sinus cases with tonsillectomy by the LaForce method, local and general anæsthesia.

Wednesday, October 26

J. F. X. JONES and staff—9. General surgery.
JOHN A. MCGLINN—9. Gynecology.
W. J. RYAN—11. Demonstration of results in treatment of fractures.
J. P. MANN—2. Demonstration of cases with operation for diseases of the hip joint.

Thursday, October 27

G. M. DORRANCE—9. General surgery.
J. C. HIRST—9. Clinic on prolapse of the uterus.
J. W. BRANSFIELD—11. Treatment of burns by use of acetic acid method.
E. C. MURPHY—11:30. Application of plaster cast in fracture of neck of femur.

Friday, October 28

J. F. X. Jones and staff—9. General surgery.
ALFRED HEINEBERG—9. Uterine endoscopy.
J. F. X. JONES and W. J. RYAN—2. Demonstration of results of hernia operations.
B. D. PARRISH—2. Demonstration of mastoid cases with indications for each.

WOMAN'S MEDICAL COLLEGE

Tuesday, October 25

ALICE W. TALLANT—9. Obstetrics.
E. G. ALEXANDER—10. General surgery.
H. C. DEAVER—11. General surgery.

Wednesday, October 26

ELLA B. EVERITT—9. Gynecology.
MARGARET BUTLER—2. Rhinology.
MARY BUCHANAN—3. Ophthalmology.

Thursday, October 27

ELLA B. EVERITT—9. Gynecology.

AMERICAN HOSPITAL FOR DISEASES OF THE STOMACH

Thursday, October 27

W. WAYNE BABCOCK—10. Gastric surgery.
LEWIS BRINTON—11. Clinical demonstrations of gastro-intestinal diseases.

Friday, October 28

J. B. CARNETT—9. General surgery.
FRANK WHITE—10. General surgery.
J. C. HIRST—11. Gynecology.

PROTESTANT EPISCOPAL HOSPITAL

Tuesday, October 25

A. P. C. ASHHURST and I. M. BOYKIN—9. General surgery.
LOUIS H. MUTSCHLER—11. General surgery.
G. ORAM RING—3. Ophthalmology.

Wednesday, October 26

A. BRUCE GILL—9. Orthopedic operations.
H. G. GOLDBERG—2. Ophthalmology. Cataract cases.
J. P. GALLAGHER and E. COLLINS—3. Ear, nose and throat. Ethmoid cases.

Thursday, October 27

H. C. DEAVER and E. G. ALEXANDER—9. General surgery.
T. R. NEILSON—11. General surgery.
CHARLES C. BIEDERT and T. R. CURRIE—2. Ear, nose and throat operations.

Friday, October 28

A. P. C. ASHHURST and EDWARD T. CROSSAN—9. General surgery.
A. P. C. ASHHURST and RALPH S. BROMER—2. Dry bone clinic: cystic disease and sarcoma.

MOUNT SINAI HOSPITAL

Tuesday, October 25

J. C. HIRST—9. Gynecology.
GEORGE ROSENBAUM—11. X-ray demonstrations.
A. WATSON—2. Nose and throat operations.
C. W. LEFEVER—4. Eye operations.

Wednesday, October 26

M. BEHREND—9. General surgery.
L. FISHER—2. Nose and throat operations.
A. I. RUBENSTONE—2. Surgical pathology and blood transfusion.
C. S. HIRSCH—4. Genito-urinary surgery.

Thursday, October 27

L. BRINKMAN—9. Gynecology.
GEORGE ROSENBAUM—11. X-ray demonstrations.

Friday, October 28

J. C. HIRST—9. Gynecology.
M. BEHREND—11. General surgery.
L. FISHER—2. Nose and throat operations.
S. J. GITTELSON—3. Eye operations.
A. I. RUBENSTONE—4. Surgical pathology and blood transfusion.

ST. CHRISTOPHER'S HOSPITAL

Tuesday, October 25

FREDERICK KRAUSS—2. Mastoid clinic.
R. R. WILLOUGHBY—4. Tonsil and adenoid operations.

Wednesday, October 26

ROBERT GRAY—9. Orthopedic operations.
E. G. ALEXANDER—11. General surgery.

Thursday, October 27

C. A. CURRIE—10:30. Tonsil and adenoid operations.
DR. ADAMS—2. Operative eye clinic.

HAHNEMANN HOSPITAL

Tuesday, October 25

H. L. NORTHROP—9. General surgery.
N. F. LANE and W. D. CULIN—9. Gynecology.
F. H. WIDMAN—2. Demonstration of the electrocardiograph.
C. BARTLETT—2:30. Relation of electrocardiograph to operative surgery.
W. G. SCHMIDT—2:45. Hydrogen-ion concentration.
G. H. WELLS—3:15. Acidosis.
J. S. HEPBURN—3:30. Blood chemistry.
W. R. WILLIAMS—4. Application of blood chemistry to clinical surgery.

Wednesday, October 26

G. A. VAN LENNEP—9. General surgery.
J. E. JAMES, JR.—9. Prenatal care.
J. D. ELLIOTT—2. Treatment of cancer with the knife and Coley's fluid.
H. L. NORTHROP—2:30. Treatment of cancer with electrothermic cautery.
F. C. BENSON—3. Treatment of cancer with radium.
J. W. FRANK—3:30. Treatment of cancer with X-rays; presentation of cases.

Thursday, October 27

H. P. LEOPOLD—9. General surgery.
D. B. JAMES—9. Gynecology.

Friday, October 28

L. T. ASHCRAFT—9. Urology.
W. C. MERCER—9. Obstetrics.
F. J. FROSCH—2. Physiology and pathology of the endometrium.
S. W. SAPPINGTON—3. Basal metabolism, with demonstrations and technique.
J. D. ELLIOTT—3:30. Tumors of the breast.
J. A. BROOKE—4. Acute infectious arthritis.

STETSON HOSPITAL

Tuesday, October 25

B. M. ANSPACH—9. Gynecology.
W. K. NEELY—2. Obstetrics.

Wednesday, October 26

S. E. TRACY—9. Gynecology. Sterilization and operating room technique.
CARL LEE FELT—2. Laryngology.

Thursday, October 27

J. A. BOGER and W. T. ELLIS—9. General surgery.

Friday, October 28

S. E. TRACY—9. Gynecology. Sterilization and operating room technique.
CARL LEE FELT—2. Laryngology.

KENSINGTON HOSPITAL FOR WOMEN

Wednesday, October 26

E. G. ALEXANDER—9. Gynecology.
H. C. DEAVER—11. Gynecology.

Friday, October 28

DANIEL LONGAKER—9. Obstetrics.
W. E. PARKE—11. Gynecology.

MISERICORDIA HOSPITAL

Tuesday, October 25

JAMES A. KELLY—9. General surgery.
ERNEST LAPLACE—9. General surgery.
CORNELIUS MCCARTHY—2. Nose and throat.

Wednesday, October 26

J. F. X. JONES—9. General surgery.
GEORGE P. MULLER—9. General surgery.
THOMAS F. BYRNE—2. Nose and throat.

Thursday, October 27

JAMES A. KELLY—9. General surgery.
ERNEST LAPLACE—9. General surgery.

Friday, October 28

J. F. X. JONES—9. General surgery.
GEORGE P. MULLER—9. General surgery.
LOUIS LOVE—2. Ophthalmology.

ST. JOSEPH'S HOSPITAL

Tuesday, October 25

JOSEPH M. SPELLISY—9. Orthopedics.
JOHN F. X. JONES—10:30. General surgery.
GEORGE MORLEY MARSHALL and WILLIAM E. QUICKSALL—2. Otology and laryngology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—2. Ophthalmology.

Wednesday, October 26

JAMES A. KELLY—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—11. Gynecology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—2. Ophthalmology.

Thursday, October 27

MELVIN M. FRANKLIN—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—10:30. Gynecology.

Friday, October 28

CHARLES F. NASSAU—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—11. Gynecology.
GEORGE MORLEY MARSHALL and WILLIAM E. QUICKSALL—2. Otology and laryngology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—2. Ophthalmology.

WOMEN'S HOMEOPATHIC HOSPITAL

Tuesday, October 25

DRS. W. E. STRONG, ROCHESTER and HARTLEY—9. General surgery.
DRS. PALEN, CLAY and CRISWELL—2. Eye, ear, nose and throat.

Wednesday, October 26

L. T. ASHCRAFT—9. Urology.
W. C. BARKER—2. Roentgenology.

Friday, October 28

DRS. BROOKE and LARER—9. Orthopedics.
DRS. CALEY, HUGHES and D. B. JAMES, JR.—10:30. Gynecology.
J. A. BROOKE—2. Obstetrics.

SAMARITAN HOSPITAL

Tuesday, October 25

H. HUDSON—9. Orthopedics.
WILLIAM A. STEEL—10. General surgery.
WILMER KRUSEN—12. Gynecology.
LUTHER C. PETER—2. Ophthalmology.
WILLIAM A. HITSCHLER—3. Rhino-laryngology.
J. H. CLARK and EUGENE ASNIS—4. Clinical pathology.

Wednesday, October 26

J. O. BOWER—9. Malignant disease.
W. WAYNE BABCOCK—10. General surgery.
COLLIER F. MARTIN—12. Rectal surgery.
WILLIAM E. ROBERTSON—2. Basal metabolism.

Thursday, October 27

G. C. BIRD—9. X-ray diagnosis.
W. HERSEY THOMAS—10. Urology.
J. O. ARNOLD—11. Obstetrics.
FRANK HAMMOND—12. Gynecology.

Friday, October 28

WILLIAM E. ROBERTSON—9. Electrocardiogram.
W. WAYNE BABCOCK—10. General surgery.
WILMER KRUSEN—12. Gynecology.
EDWIN MITCHELL—2. Laryngology.
HENRY J. OFF—3. Otology.
H. BOOKER MILLS—4. Pediatrics.

WOMAN'S HOSPITAL

Tuesday, October 25

MARY THOMAS MILLER—9. Obstetrics.
LYDIA STEWART COGILL—10. Obstetrics.
ELLA WILLIAMS GRIM—11. Obstetrics.
ANN TOMKINS GIBSON—12. Obstetrics.
LAURA EMMA HUNT—2. Nose, throat and ear.

Wednesday, October 26

CATHERINE MACFARLANE—9. Gynecology.
CAROLINE M. PURNELL—11. Gynecology.
MARGARET WARLOW—2. Nose, throat and ear.
MARY GETTY—2. Eye.

Thursday, October 27

MARIE K. FORMAD—9. Gynecology.
SARAH H. LOCKREY—11. Gynecology.

Friday, October 28

KATE W. BALDWIN—9. Spectro-chrome therapy or attuned color waves as an adjunct to general surgical work.

JEWISH HOSPITAL

Tuesday, October 25

W. H. TELLER—9. General surgery.
C. S. HIRSCH—9. Urology.
E. STEINFIELD—10. Serology and bacteriology.
H. M. GODDARD—2. Rhinology.
S. L. FELDSTEIN—2. Roentgenology.

Wednesday, October 26

F. B. BLOCK—9. Pelvic surgery.
A. REISS—12. Electrotherapy.
S. F. FELDSTEIN—2. Roentgenology.
C. STAMM—2. Obstetrics.
A. W. WATSON—3. Rhinology.

Thursday, October 27

M. BEHREND—9. General surgery.
E. STEINFIELD—10. Serology and bateriology.

Friday, October 28

C. S. HIRSCH—9. Cystoscopy and urology.
L. BRINKMAN—10. General surgery.
S. L. FELDSTEIN—2. Roentgenology.
G. W. SHOLLER—2.30. Gyneoclogy.

CHILDREN'S HOMEOPATHIC HOSPITAL

Tuesday, October 25

H. P. LEOPOLD—11. General surgery.

Wednesday, October 26

BAYARD KNERR—11. Nose and throat.
F. W. SMITH, OSCAR SEELEY, and O. F. BARTHMAIER—2. Pathological studies.

Thursday, October 27

JOHN A. BROOKE—2. Orthopedics.

ST. LUKE'S HOSPITAL

Tuesday, October 25

DESIDERIO ROMAN—9. General surgery.
O. F. BARTHMAIER and J. W. POST—2. Group study of the thyroid; laboratory, roentgenology, surgery.

Friday, October 28

DESIDERIO ROMAN—9. General surgery.
I. G. SHALLCROSS—11. Eye clinic.
J. W. POST—2. Roentgenological study of chronic arthritis as a basis for differential diagnosis and etiology.